

Trouble-shooting instructions : OPE-5013

BOSCH system : ABS

Make of vehicle : OPEL OMEGA/SENATOR-B

Basic microcard : PKW - 063

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SPECIAL FEATURES

This microcard contains the trouble-shooting instructions, valid at the time of publication, for the following models:

\* Opel Omega 1.8 , 1.8 S , 2.0 , 2.3 ,  
2.3 TD , 3.0 → 10.86

ABS with 4 wheel-speed sensors and 3 hydraulic channels.

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :  
The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

\*For reasons of safety, the hydraulic modulator must not be repaired, but may be exchanged only as a complete unit.  
Exception: relays  
\*Do not loosen any screws on the hydraulic modulator! Danger of fatal accident owing to failure of the brakes.  
\*Take great care when handling brake fluid.  
Poison!

For further information, see brief instructions.

## TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- \* Regulatory tire size fitted?
- \* Check for firm seating of ground of return-supply pump.
- \* Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- \* Check for firm seating of ground strap between engine block and vehicle frame.
- \* Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- \* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- \* If the ABS warning lamp lights up constantly and does not go out, check the following points:
  - Controller plug sitting correctly on controller and latched?
  - All plug contacts O.K.?
  - Spring contacts latched?
  - Check installation position for correct seating of seal ring in controller plug. rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

### Wheel-speed sensors:

front left to term. 6 and term. 4,  
front right to term. 11 and term. 21.  
rear left to term. 8 and term. 9,  
rear right to term. 24 and term. 26.  
rear axle to term. - and term. -.

- V-belt snapped?  
(Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).
- \* Connect ABS 2 LED tester to ABS wiring harness.
- Disconnect and connect controller only with ignition switched off.
- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- Observe LED (green) for current supply in all program-selector-switch positions.

## C A U T I O N !

Do not drive with tester connected!

The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.

Repeat the complete test program after any repairs are carried out.

The Antiskid System is a vehicle safety system.

Work on the system demands detailed knowledge of the system.

The conventional brake system must be O.K.

## General information for trouble-shooting:

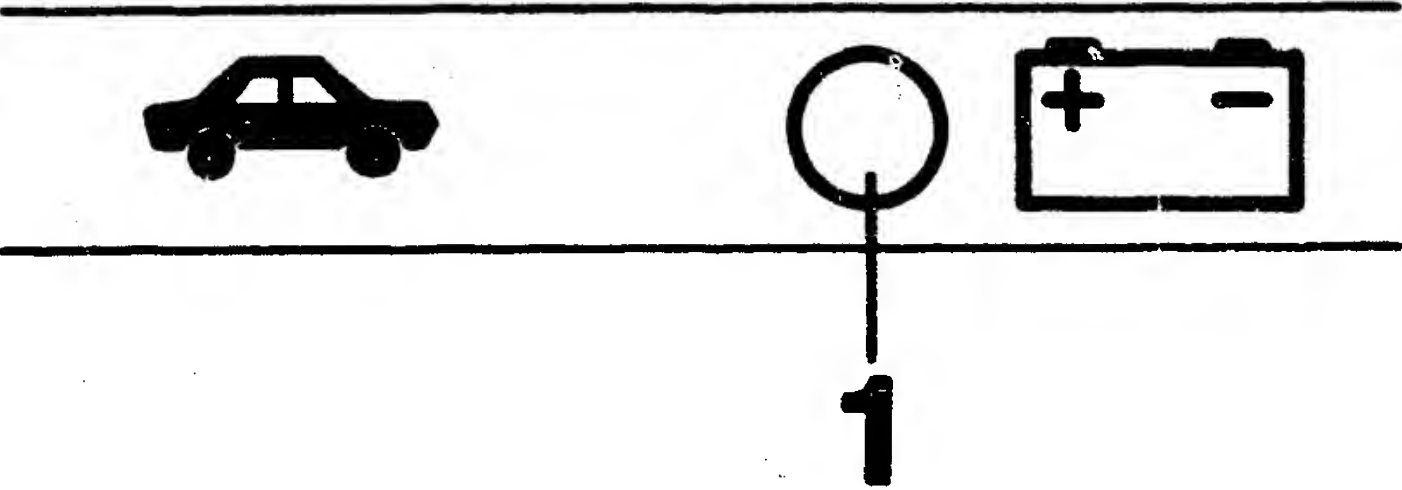
Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

RAPID DIAGNOSIS CHART

Do not drive with tester connected. Are all test conditions met?

Program-switch positions 1 to 6

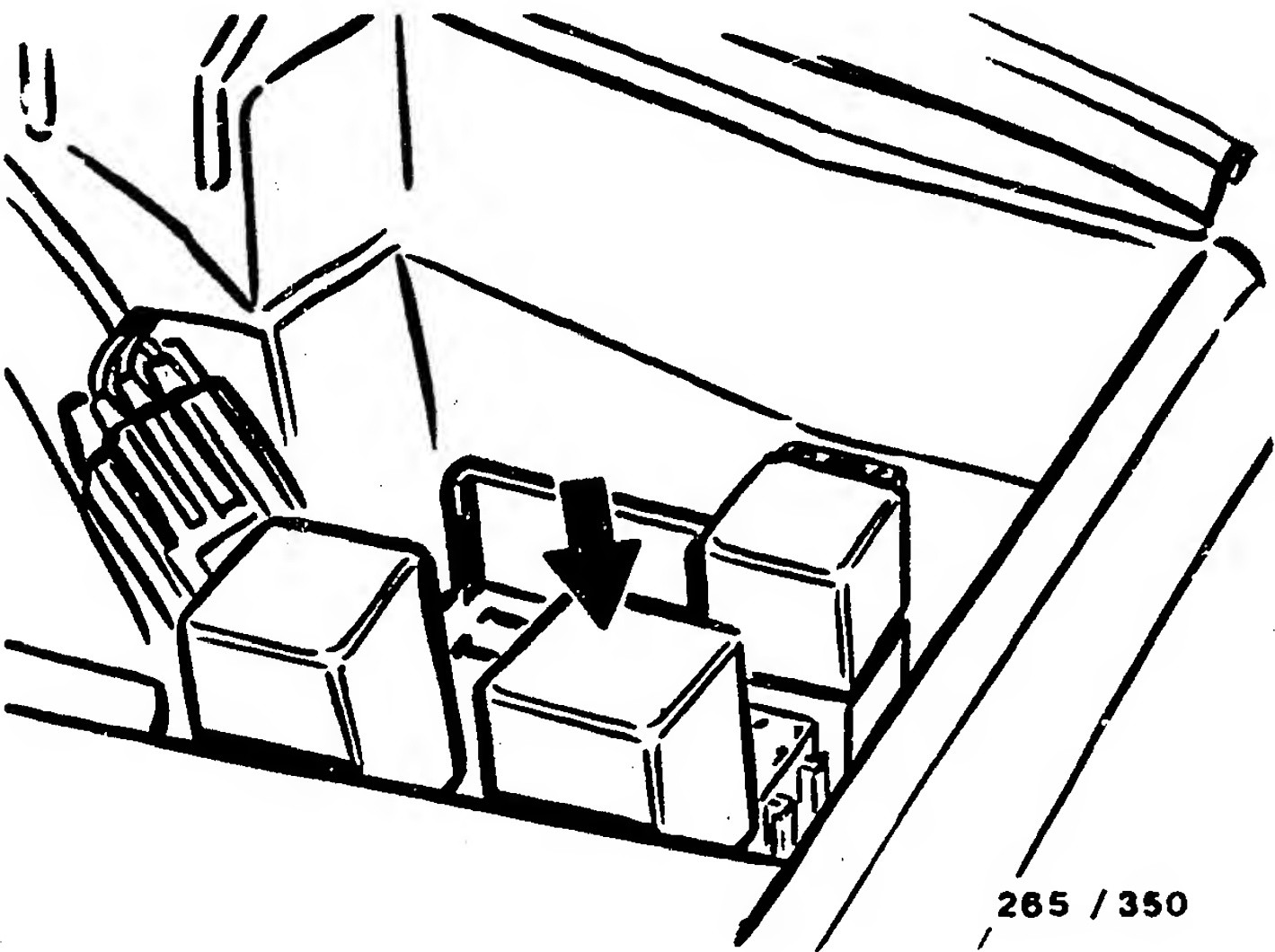
Testing of (measurement at terminals)	Additional operation	Test specifi- cation (reading)	Possible causes of faults
Power supply  (term.1 und term.20)	Ignition on	LED 1 (top picture) continuously lit	<ul style="list-style-type: none"><li>*Battery insufficiently charged</li><li>*High voltage drops</li><li>*Overvoltage-protection relay defective</li><li>*Check lead to ignition and starting switch, term. 15</li></ul>



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1 = LED for supply voltage

Arrow = Overvoltage-protection relay



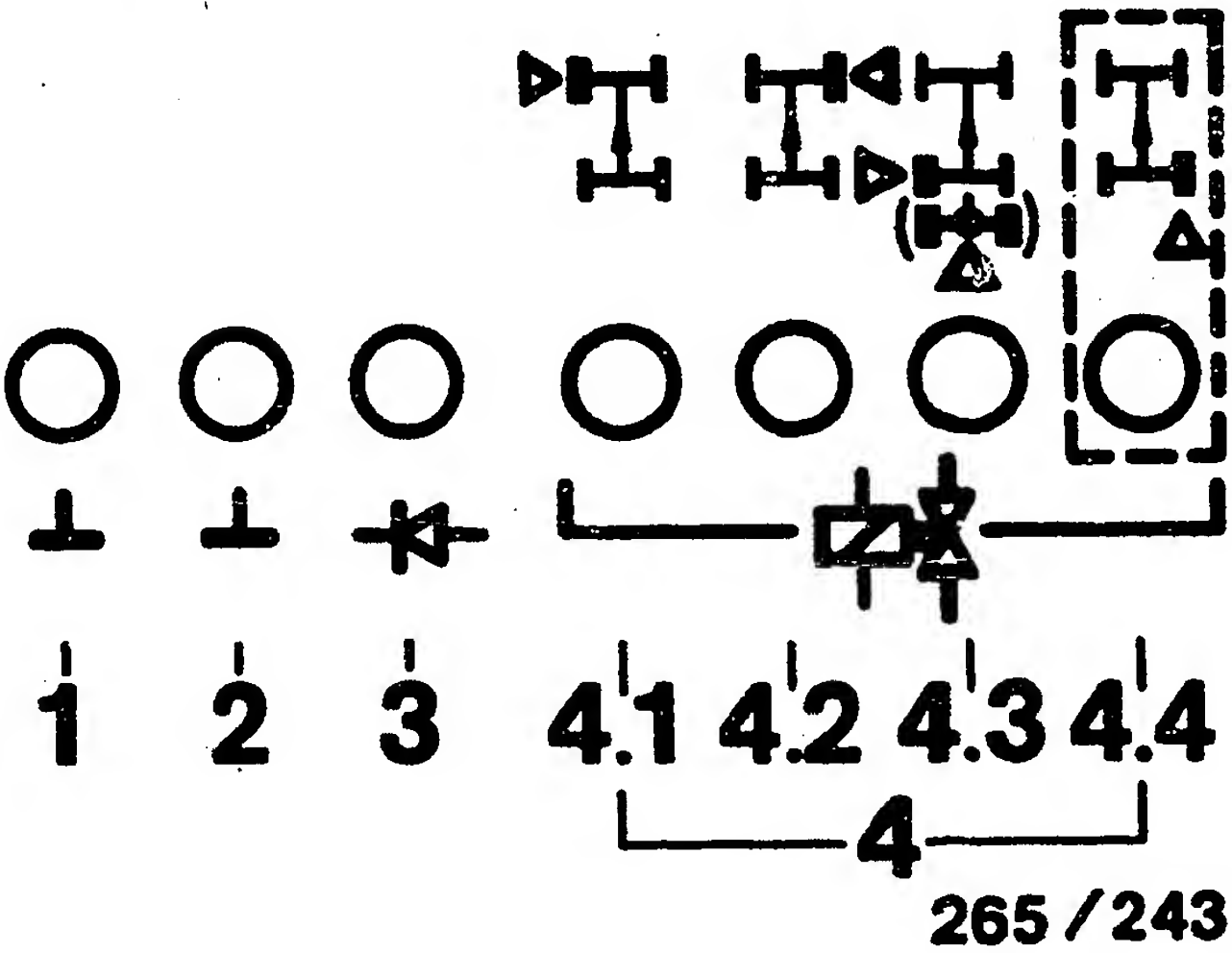
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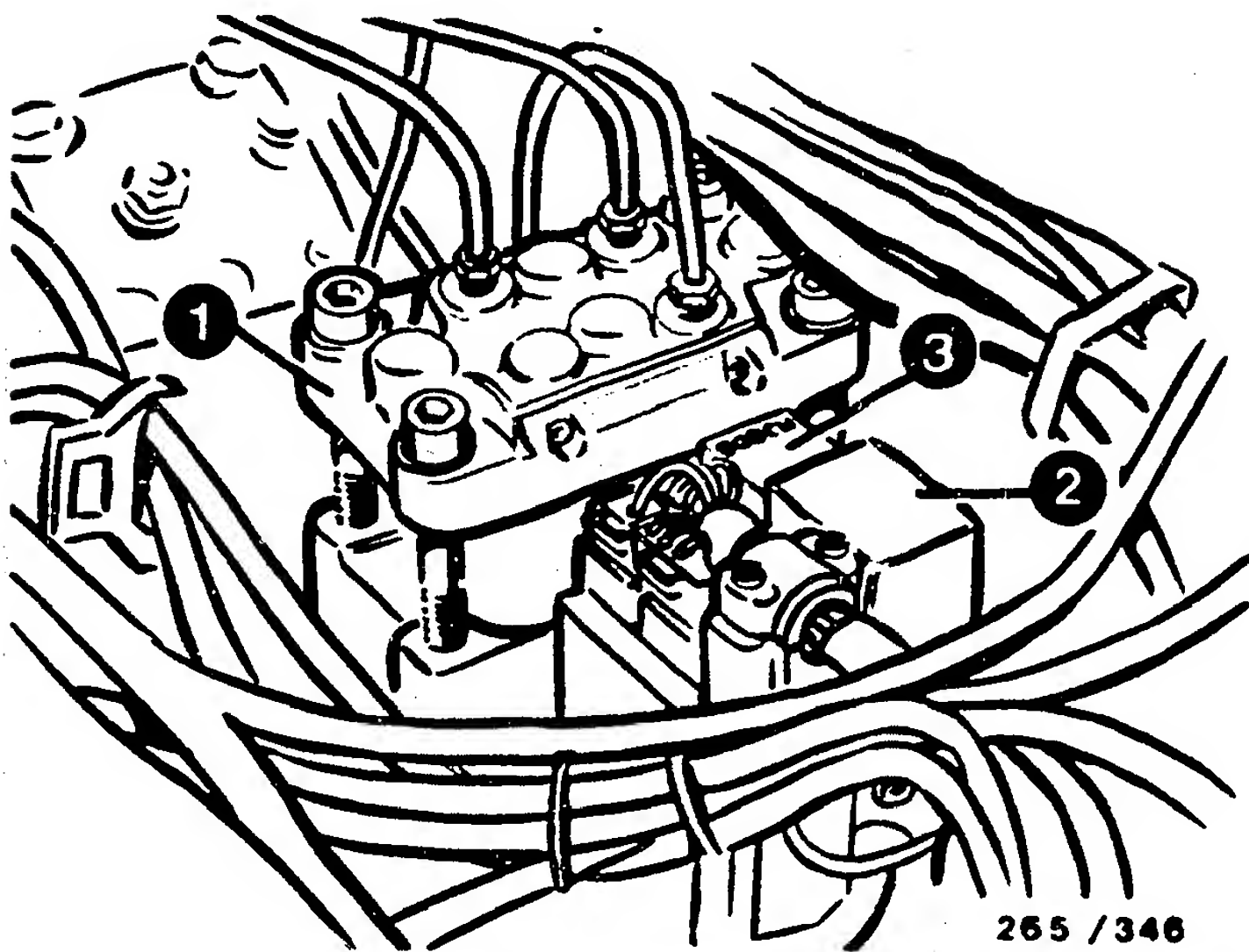
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (3-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34)  Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.-, term.35)  Off-position and ground connection of relay  ABS warning lamp	Ignition on	6 LED (1 to 4.3)  simultaneously brightly lit (top picture)  ABS warning lamp in vehicle must light up	<ul style="list-style-type: none"><li>* LED 1 and/or 2 (top picture) not lit:  Check ground terminals for open circuit.</li><li>* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.</li><li>* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid- operated valve and leads.</li><li>Solenoid-operated valve internal resistance 0,7...1,7 <math>\Omega</math></li><li>* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.</li><li>* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.</li><li>* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.</li></ul>



- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay

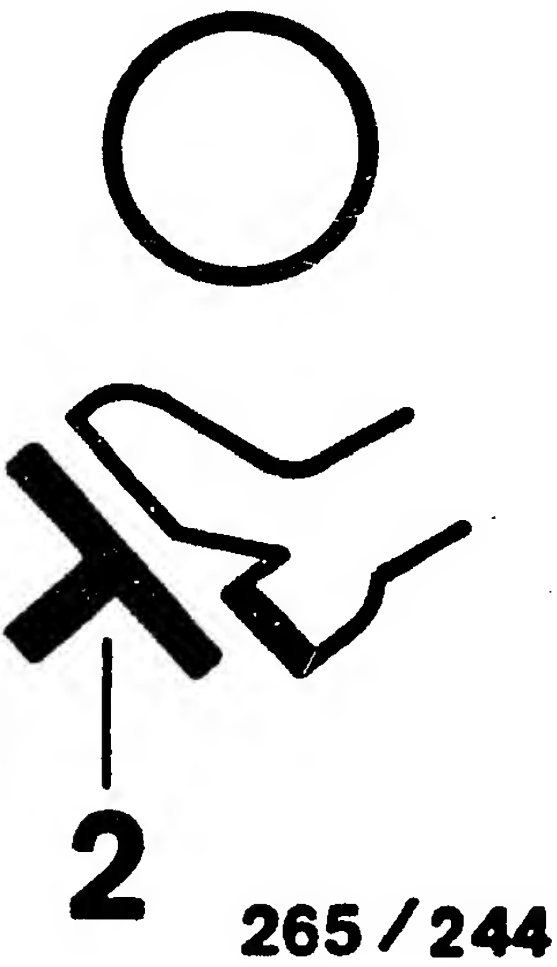




RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

Under test (Measurement at the terminals)	Additional operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61 * Alternator defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective.  * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.

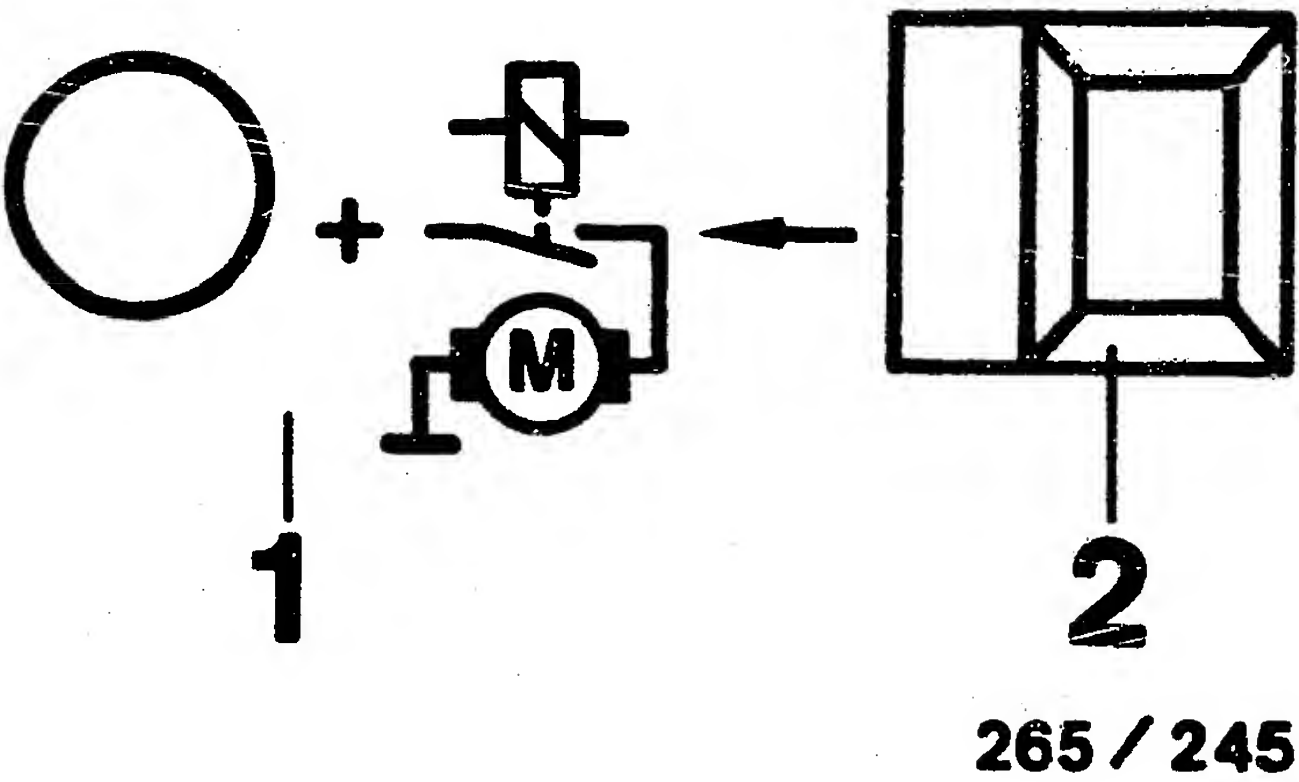


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RAPID DIAGNOSIS CHART (CONTINUED)

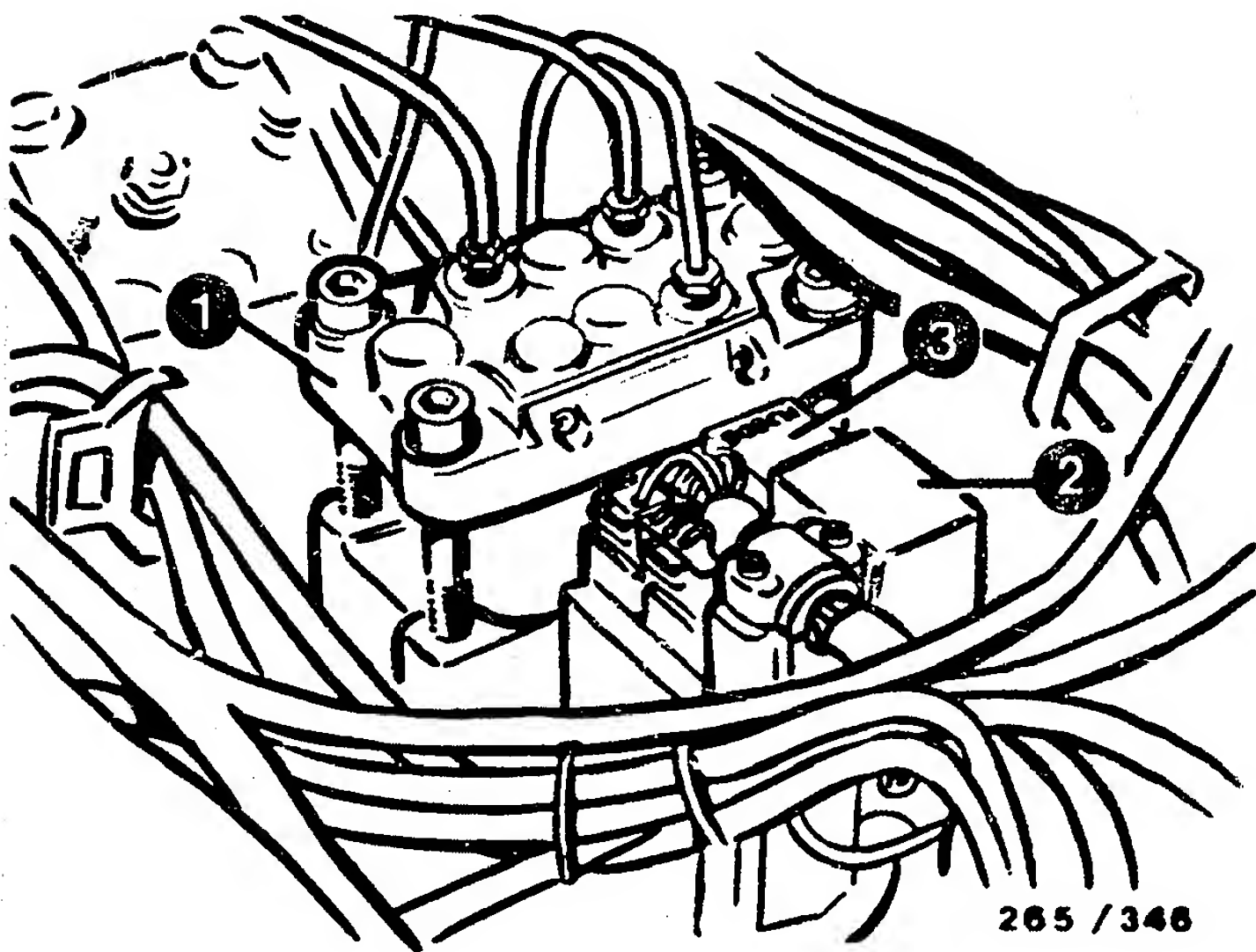
Program-selector-switch position 3

Under test (measurement at the terminals)	Additional operation	Test specifications (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.28 and term.14)	Ignition on, constantly press push- button 2 (upper ill- ustration)	LED 1 lights up, pump motor runs.  After releasing push-button, LED stays lit due to run-on of motor (upper illustration).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Check frame connection and positive terminal of pump motor</li><li>* Check following leads: from controller term. 14 and term. 28 to hydraulic modulator term. 9 or term. 11. Positive lead to hydraulic modulator term. 2.</li><li>* Pump motor or hydraulic modulator defective.</li></ul>



Program-selector-switch position 4 not applicable.

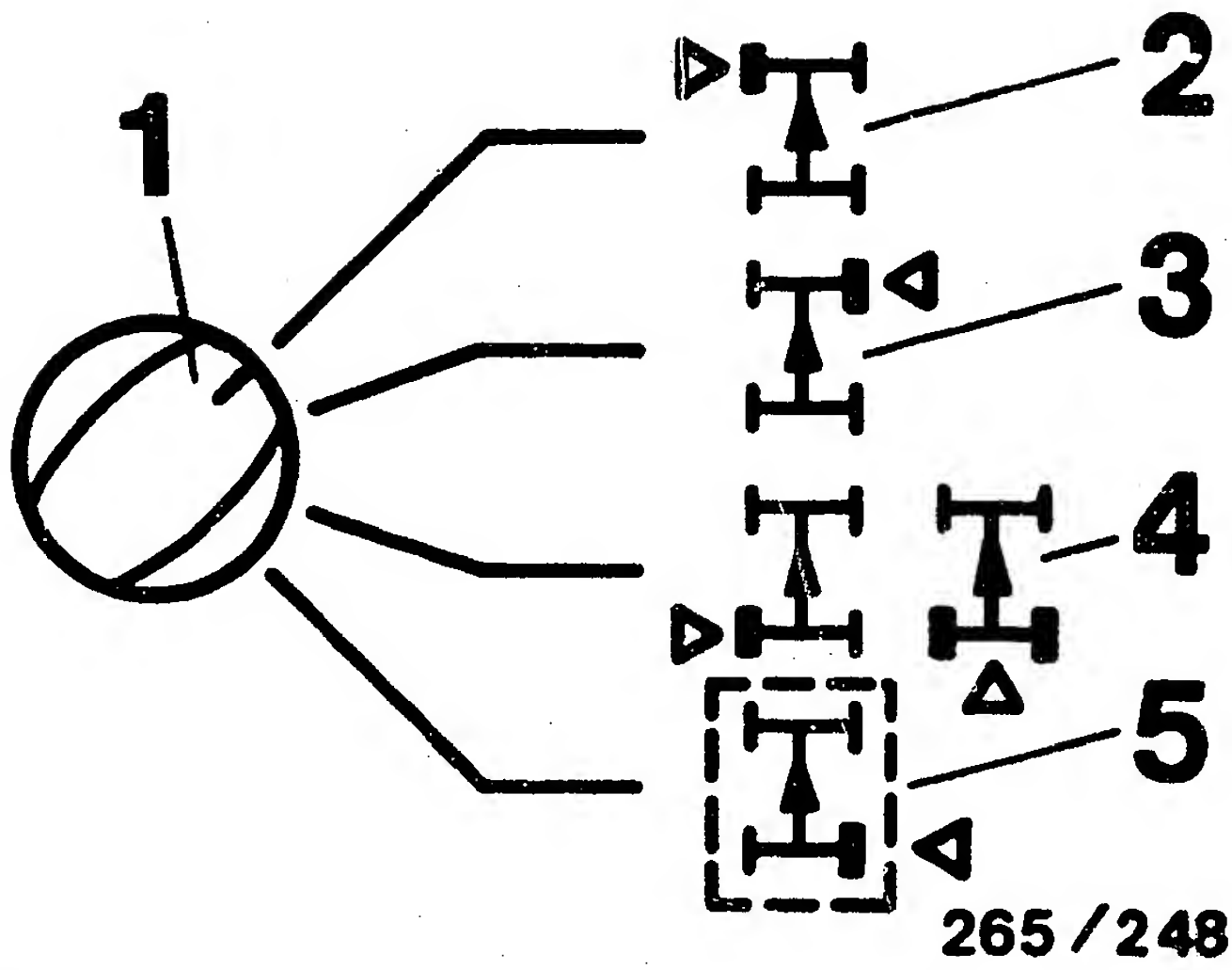
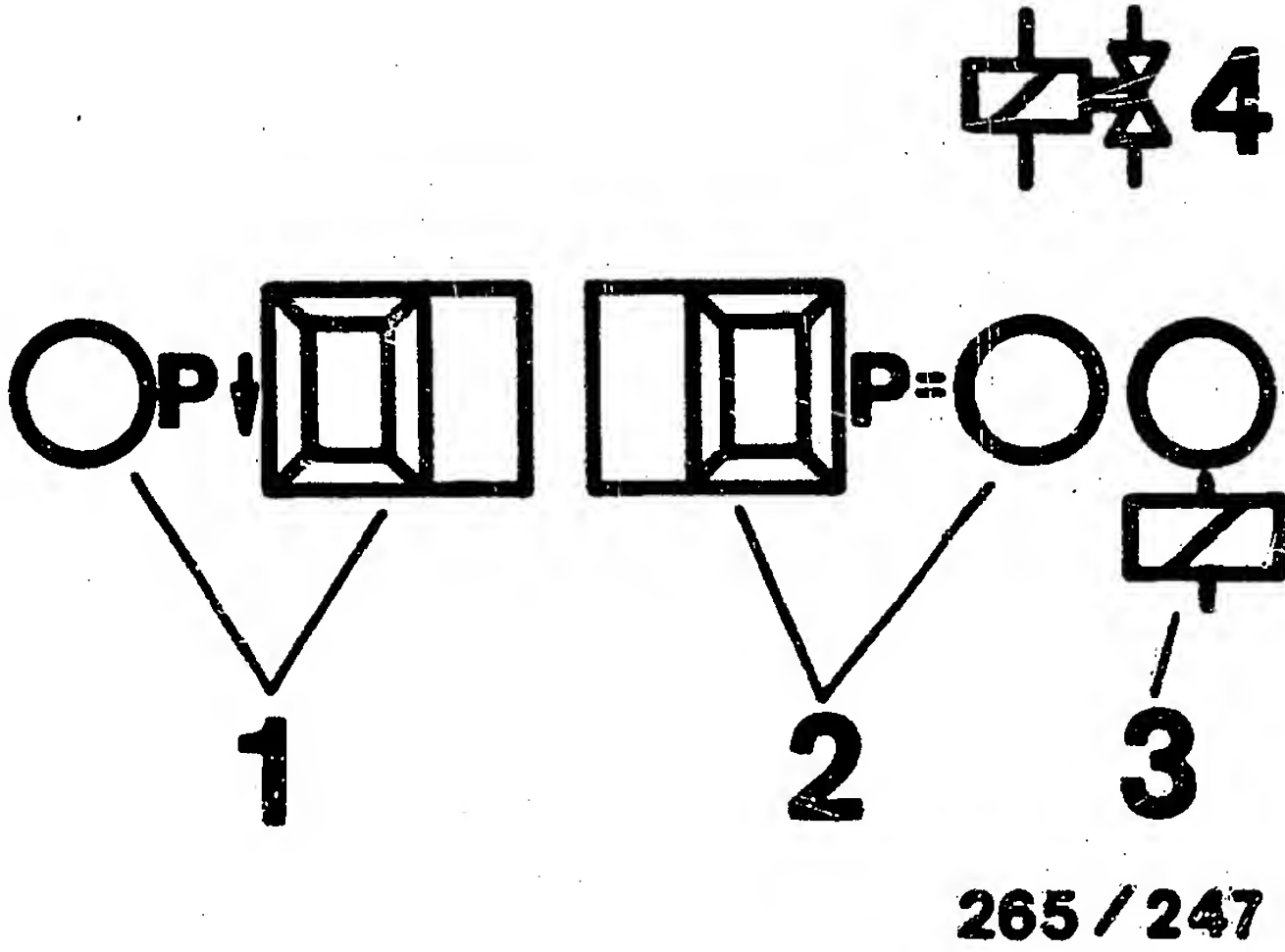
1 = Hydraulic modulator  
2 = Motor relay  
3 = Valve relay





RAPID DIAGNOSIS CHART (CONTINUED)  
Program-selector-switch position 5 (3-channel hydraulic modulator)

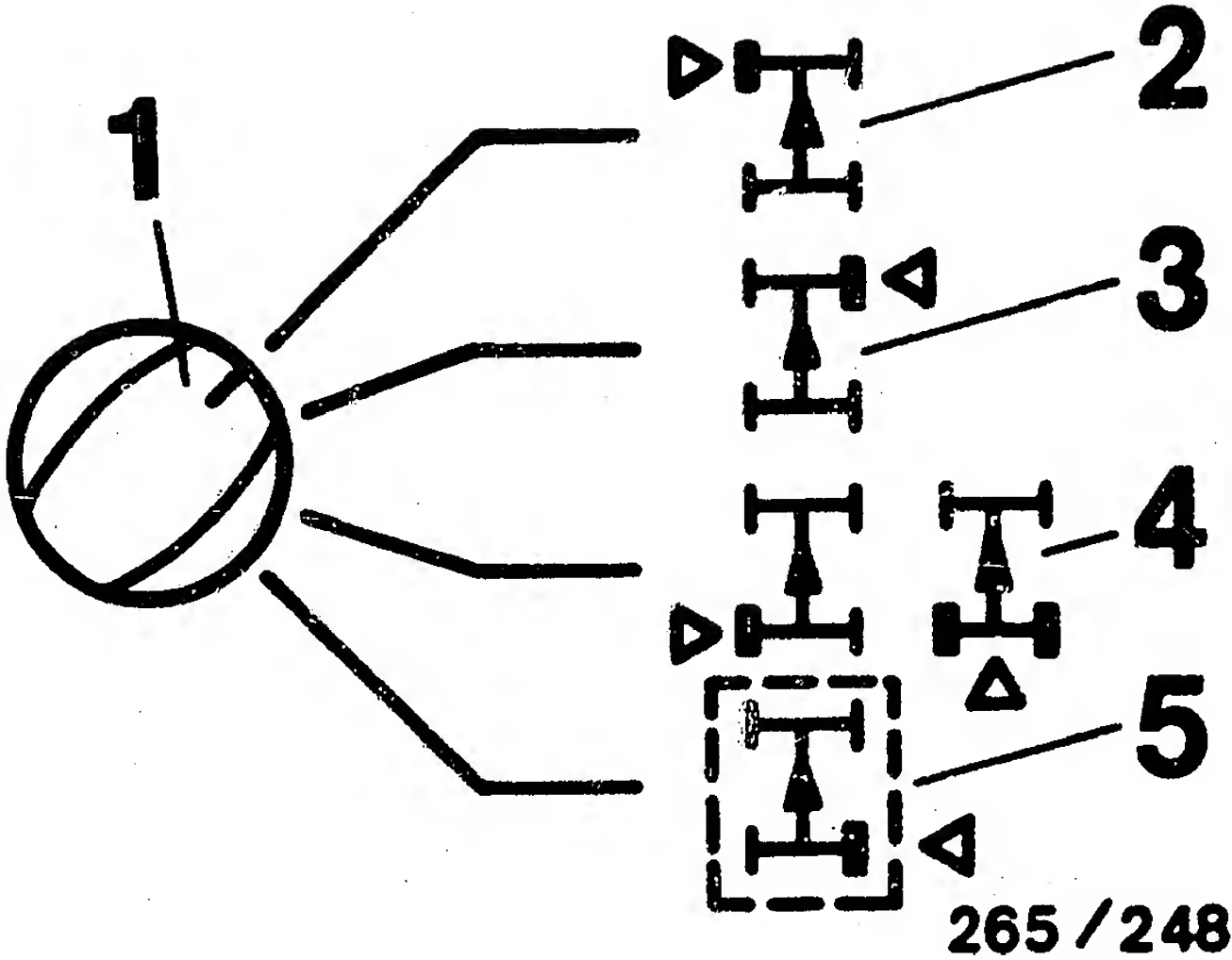
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve-relay operation (term.27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valve in hydraulic modulator for operation and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence!	Choke up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. For the rear axle, set to position 4 (lower illustration).		* Repeat test with engine running  * Valve relay (make contact) defective  * Break in line from valve relay term. 87 to batt. +ve  * Brake leads at hydraulic modulator mixed up
Operation pressure holding	1. Constantly press push-button P= (lower illus.)	LED P= (lower illus.) lights up	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly depress brake pedal	Wheel turnable by hand	
	3. Release push-button P= (upper illustration)	LED P= goes out (upper illus.) Wheel locks	
Operation pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-op. valves correctly connected electrically? Wheel, front left: term. 2 Wheel, front right: term.35 Wheel, rear left: term.- Wheel, rear right: term.- Rear axle: term.18  * Hydraulic modulator defective
	5. Release push-button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6. Release brake pedal		



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
<p>Wheel-speed sensor for operation and mix-up</p> <p>NOTE: Check each wheel separately in turn.</p> <p>Wheel, front left: term.6 and term.0,6...1,6 Wheel, front right: term.11 and term.21 Wheel, rear left: term.8 and term.9 Wheel, rear right: term.24 and term.26)</p>	<p>Chock up vehicle. Ignition on.</p> <p>The wheel being tested must be freely turnable by hand.</p> <p>When testing the driven axle, the wheel not being tested must be locked.</p> <p>Set switch for wheel selection to wheel to be tested (lower illustration)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)</p>	<p>1.Smallest reading larger 1,6 divisions</p> <p>2.Permissible fluctu- ation max. 25 % of largest reading.</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Break in wheel-speed- sensor lead</p> <p>*Wheel-speed sensor defective Winding resistance Front axle: 0,6...1,6 k <math>\Omega</math> Rear axle: 4 k <math>\Omega</math></p> <p>*Air gap between wheel-speed sensor and ring gear too wide</p> <p>*Ring gear defective or loose</p> <p>*Ring gear with incorrect number of teeth Front axle: 48 teeth Rear axle: 48 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Reading appears, LED 2 does not light up: loose contact in wheel- speed-sensor lead.</p>



Continue test with next coordinate.



## TEST SPECIFICATIONS

### Wheel-speed sensor

- \* Winding resistance at ambient temperature (-10°C...+120°C) for front axle:
- rear axle:

600...1600  $\Omega$   
600...1600  $\Omega$

### Hydraulic modulator solenoid-operated valves

- \* Winding resistance at ambient temperature (-10°C...+120°C):

0,7...1,7  $\Omega$

- Air gap: wheel-speed sensors, front
- wheel-speed sensors, rear

0,2...1,2 mm  
0,5...1,5 mm

### Tightening torque for

- \* Fastening screws of the wheel-speed sensors:

> 8 Nm

- \* Brake-line connections on the hydraulic modulator:

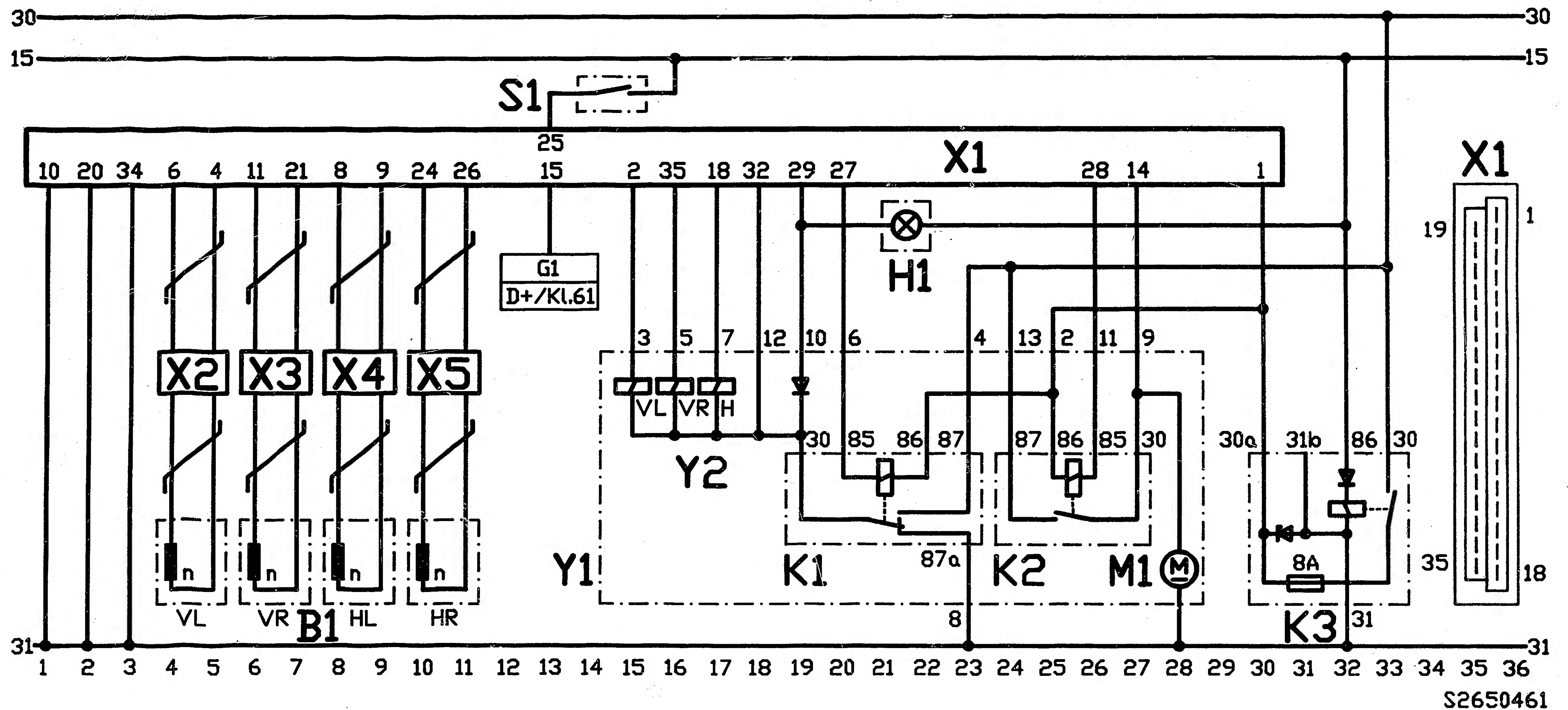
12...16 Nm

### Number of teeth

- \* Front axle:
- \* Rear axle:

48 teeth  
48 teeth

For production reasons:  
continued on the following  
coordinate.



B1 = Wheel-speed sensor  
 G1 = to alternator  
 H1 = ABS warning lamp  
 K1 = Valve relay  
 K2 = Motor relay  
 K3 = Over-voltage protection relay

M1 = Return-pump motor  
 S1 = Stop-lamp switch  
 X1 = Controller plug (35-pole)  
 X2...X5 = Multiple butt connector  
 Y1 = Hydraulic modulator  
 Y2 = Solenoid valves

VL = Front left  
 VR = Front right  
 H = Rear axle  
 HL = Rear left  
 HR = Rear right

# ELECTRICAL TERMINAL DIAGRAM

A19

A20



## INSTALLATION POSITION OF COMPONENTS

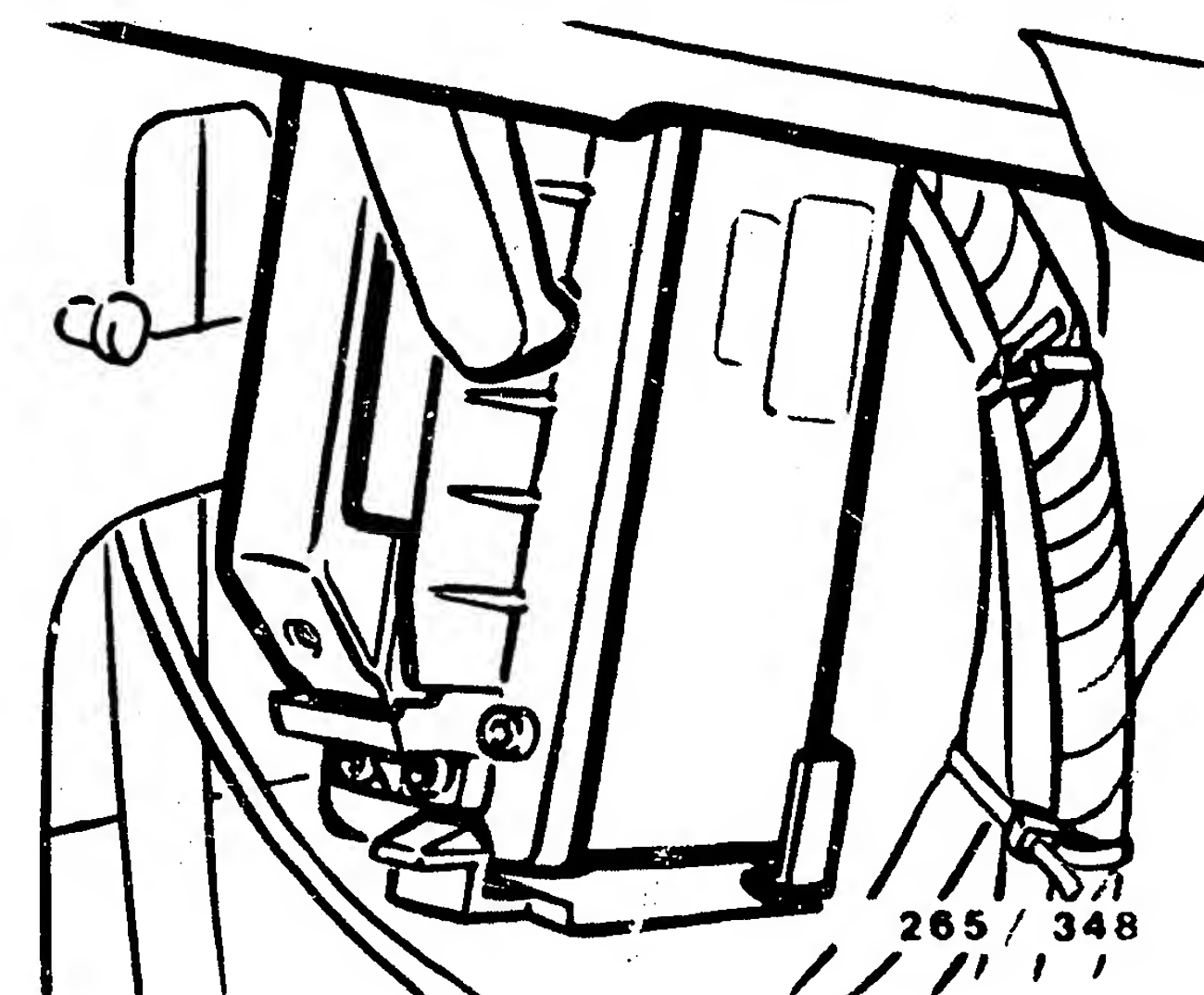
The stated installation locations are always referenced to the direction of travel.

### \* Controller:

In driver's-side footwell on left outer side (picture, top)

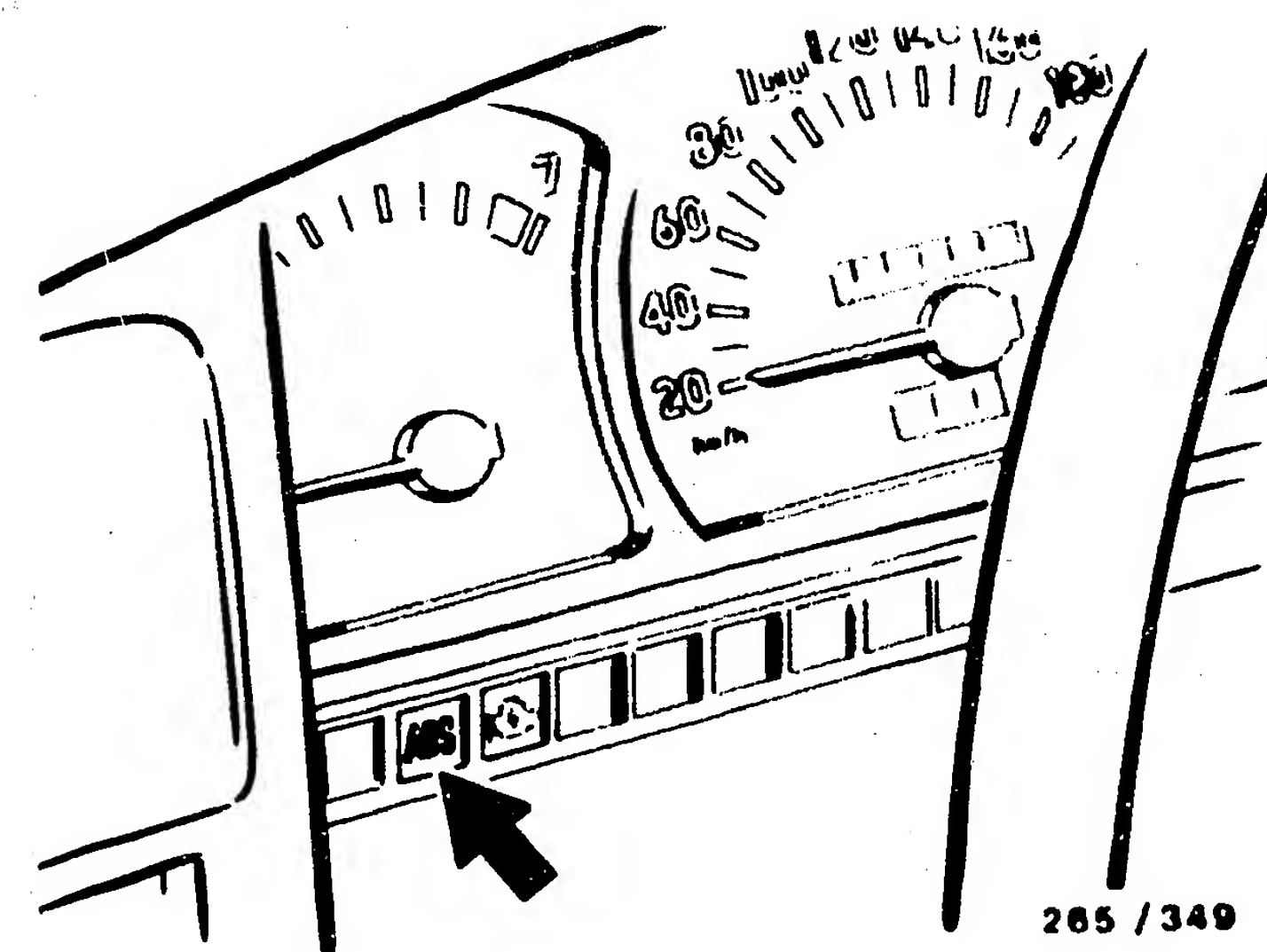
As of 09.88 beneath front left seat.

To remove, push front left seat forwards and open plastic cover.



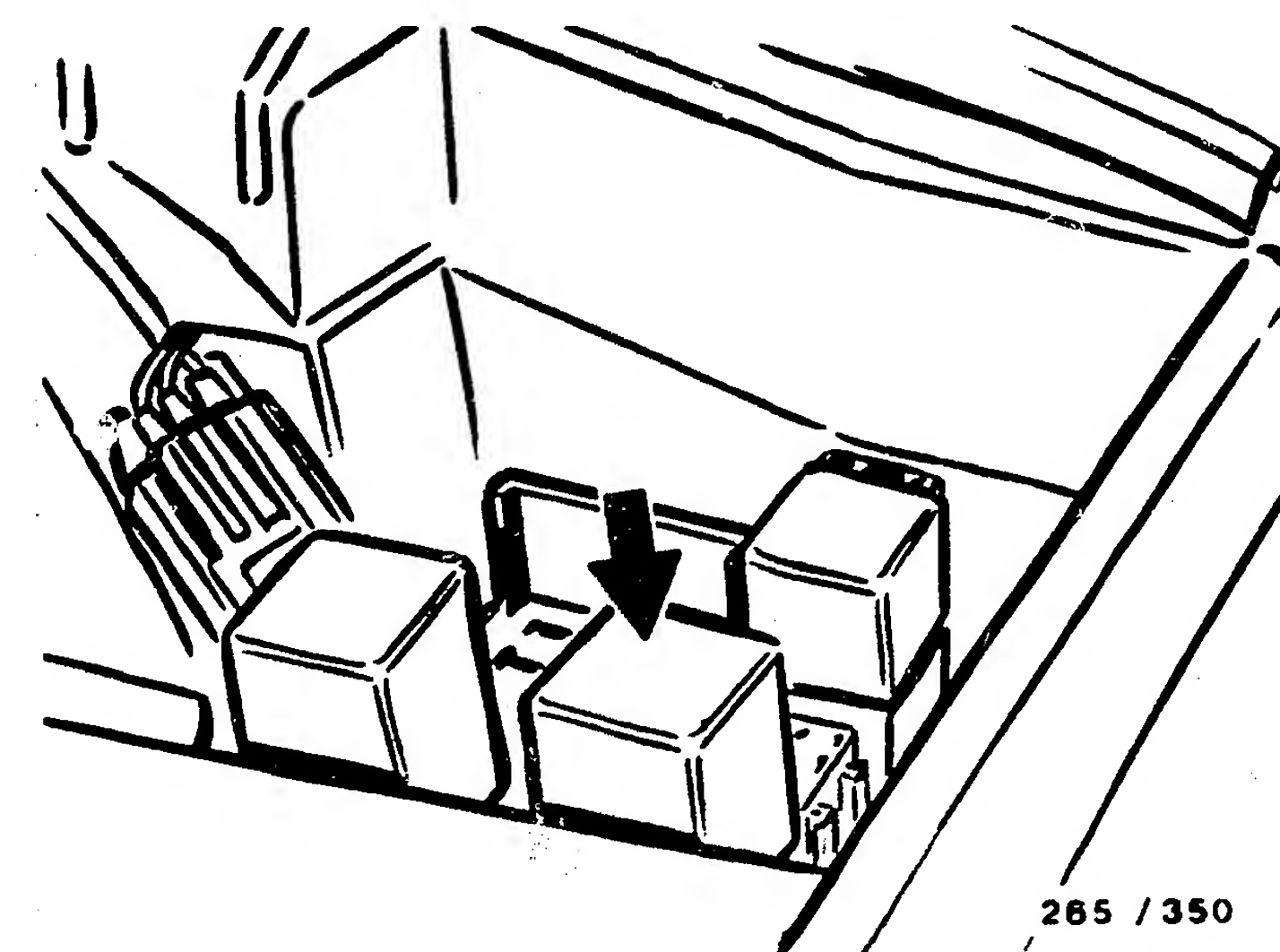
### \* ABS warning lamp: center picture

In instrument panel in indicator-lamp strip; 3rd lamp from left.



### \* Over-voltage protection relay: bottom picture

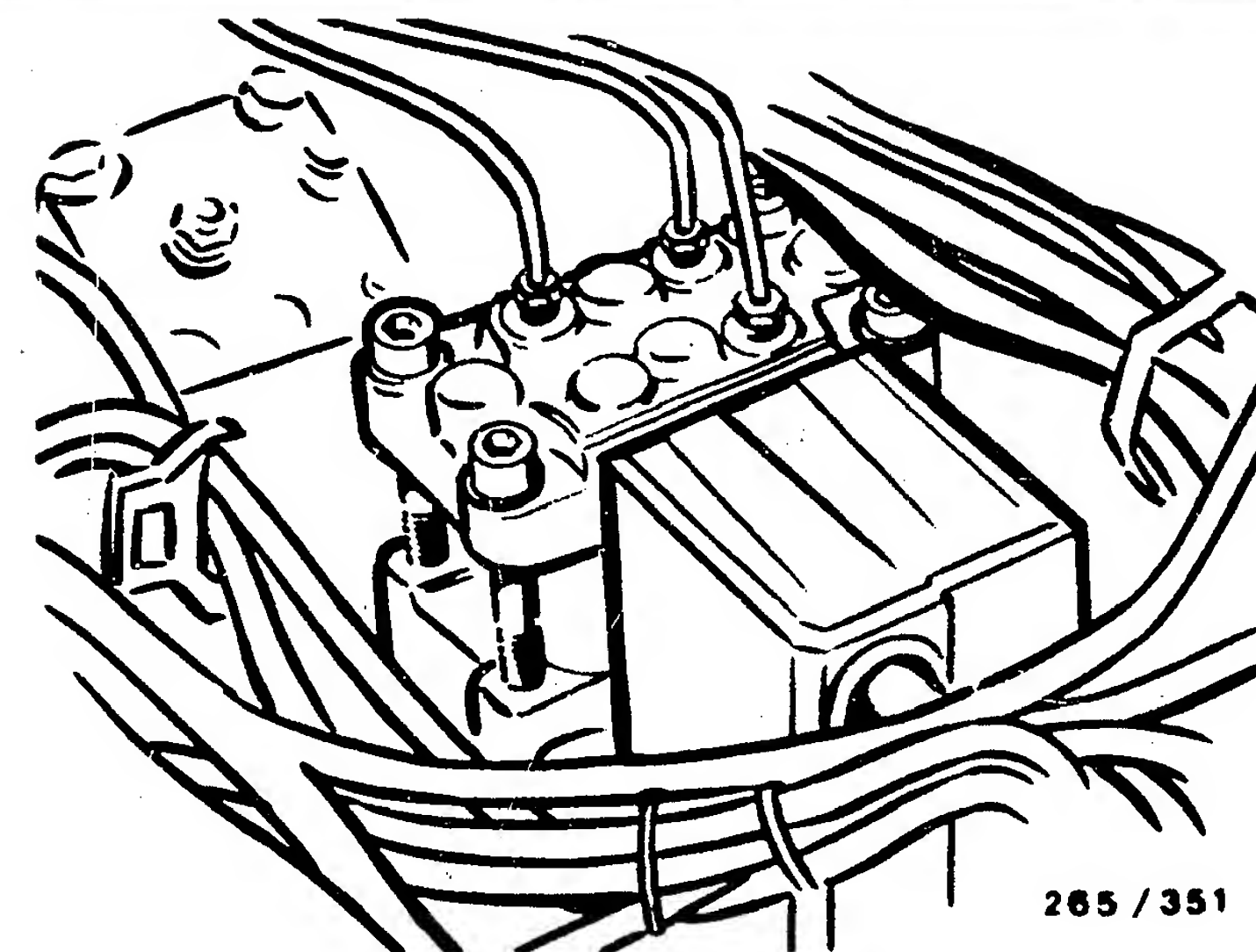
In engine compartment, on left next to bulkhead in relay holder (arrow).



## INSTALLATION POSITION OF COMPONENTS (CONTINUED)

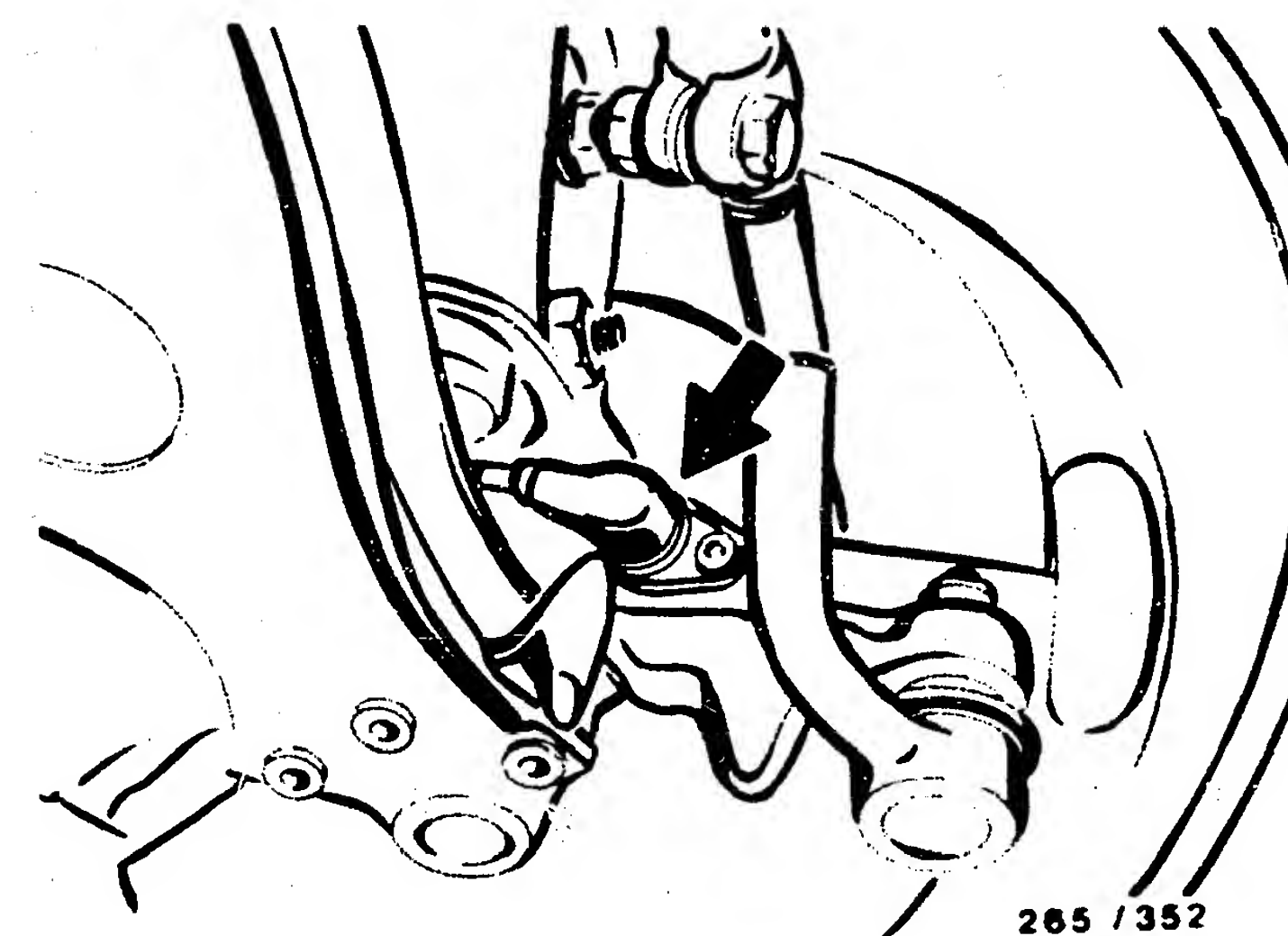
### \* Hydraulic modulator: top picture

In front left of engine compartment.



### \* Front-axle wheel-speed sensor: bottom picture

One each at either wheel in steering knuckles.  
Wheel-speed sensors cannot be adjusted.





## INSTALLATION POSITION OF COMPONENTS (CONTINUED)

\* Rear-axle wheel-speed sensor: top picture

One each to left and right of differential.

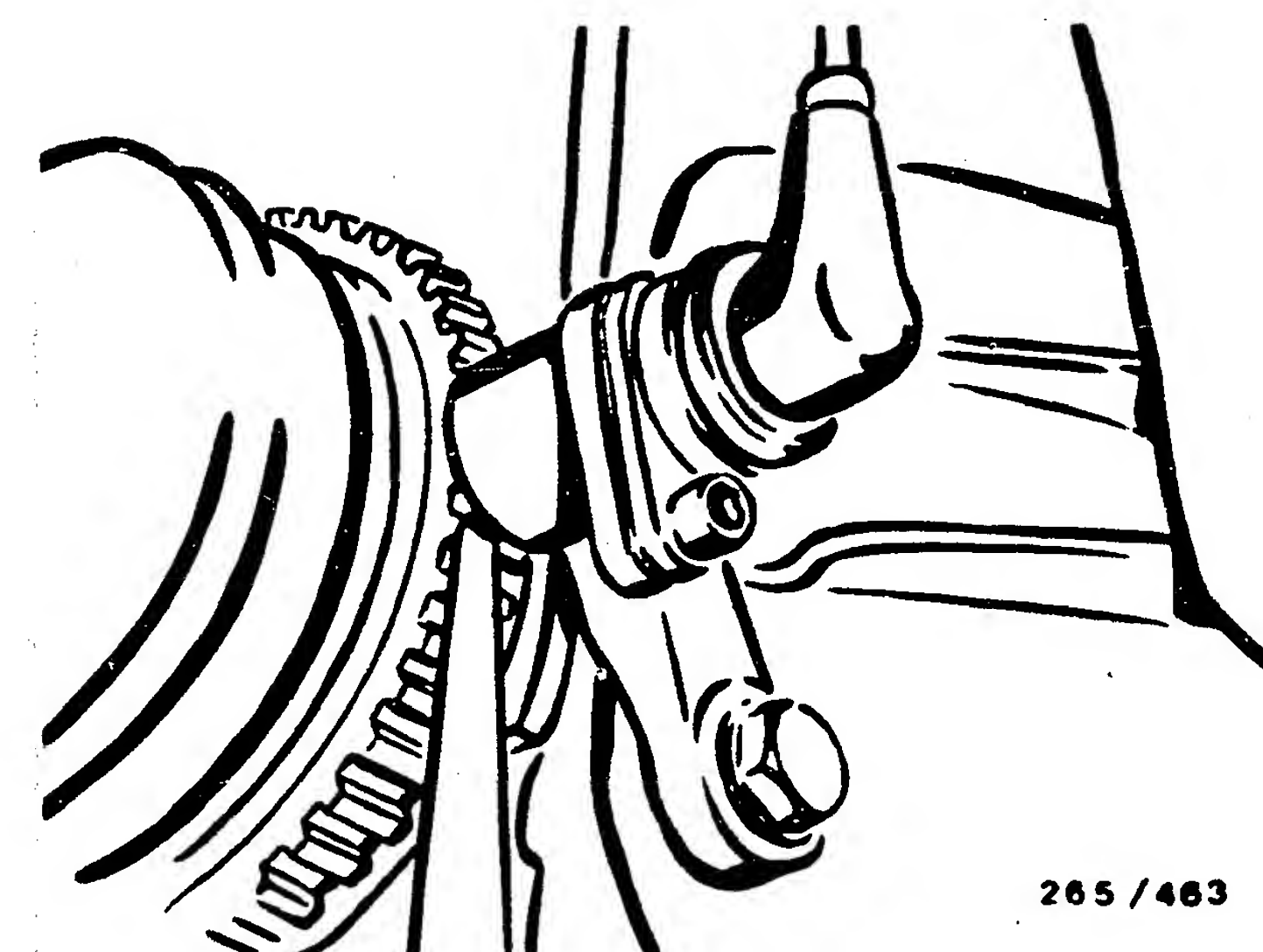
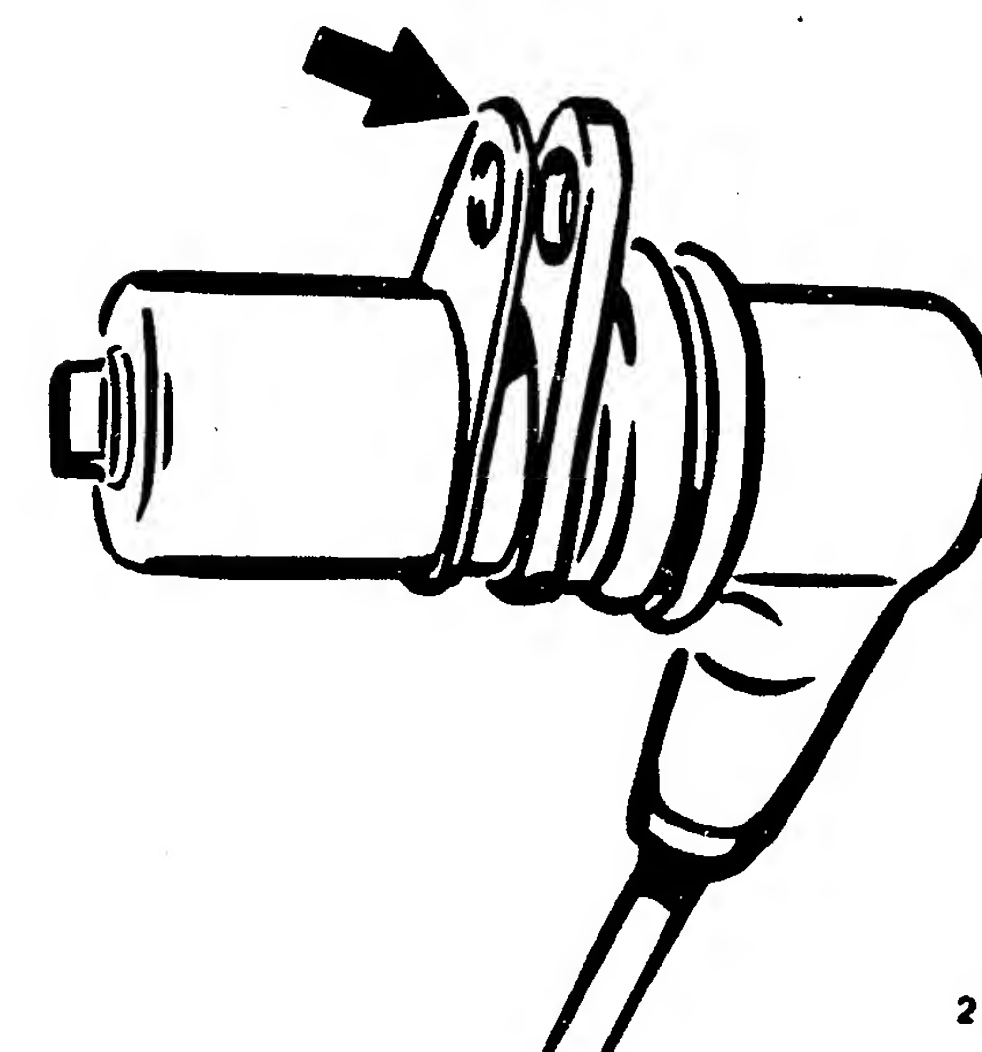
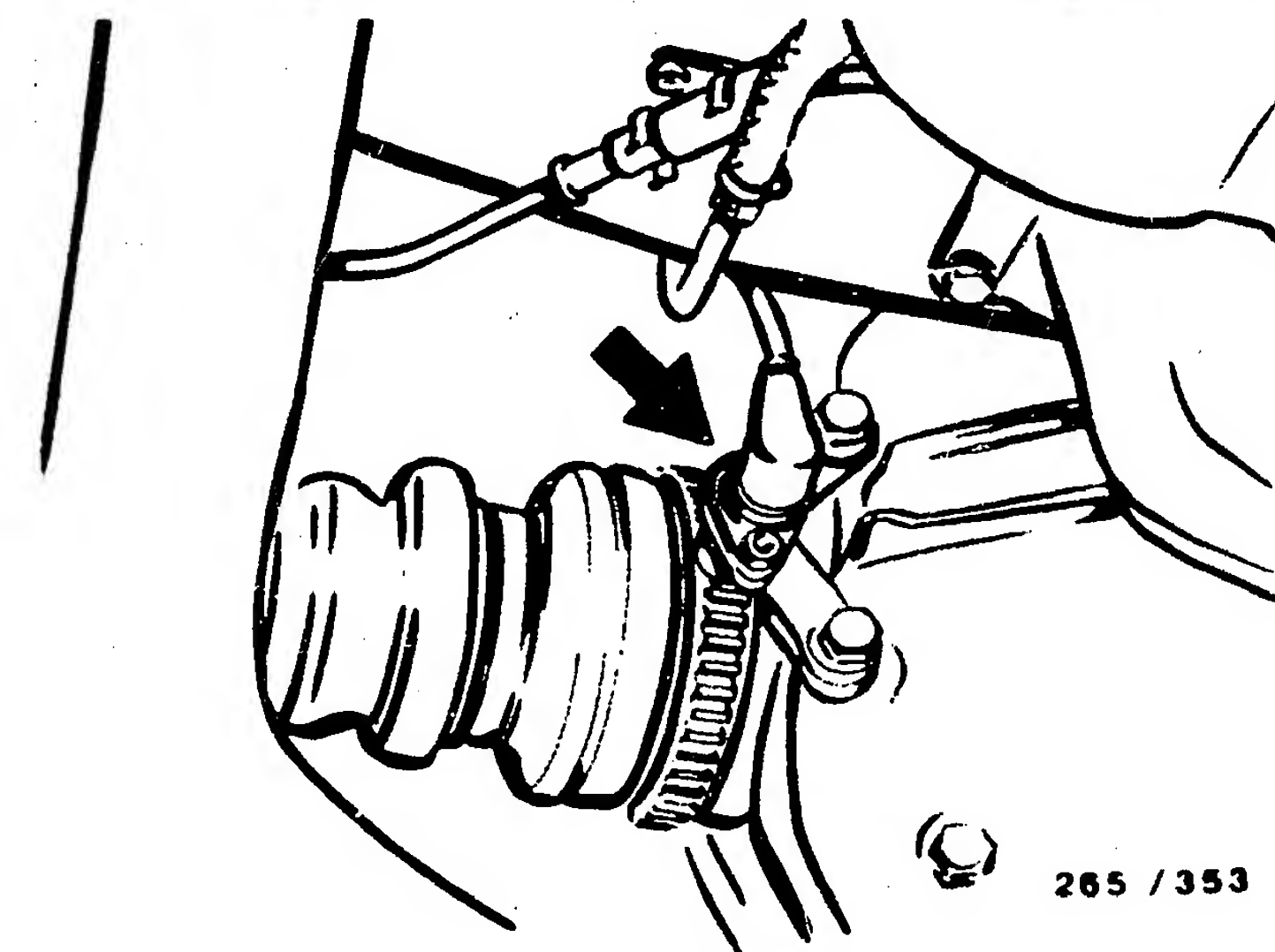
Center picture

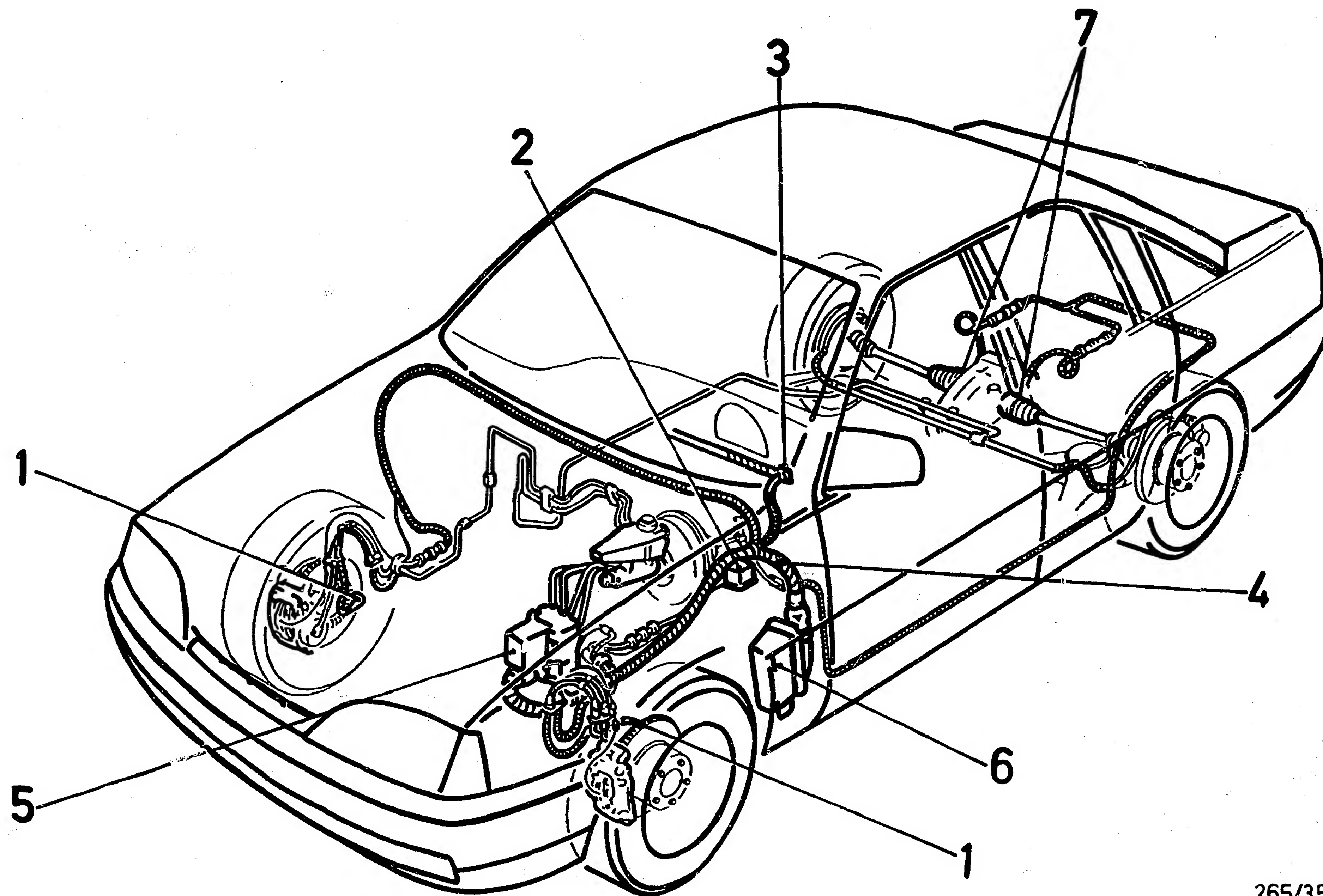
Important: pay attention to air gap when replacing wheel-speed sensors.

Air gap can be adjusted with washers (arrow).

Bottom picture

Measure air gap between ring gear and wheel-speed sensor with feeler gauge. Set air gap to between 0.5 and 1.5 mm.





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# INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- 1 = Wheel-speed sensors, front axle
- 2 = Overvoltage-protection relay
- 3 = ABS - warning lamp
- 4 = ABS - wiring harness

- 5 = Hydraulic modulator
- 6 = ABS controller
- 7 = Wheel-speed sensors, rear axle

Trouble-shooting instructions : JAG-5002  
BOSCH system : ABS  
Make of vehicle : JAGUAR  
Basic microcard : KFZ-00..

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SPECIAL FEATURES

This microcard contains the trouble-shooting instructions, valid at the time of publication, for the following models:

Jaguar XJ 6 3.6, Daimler 3.6, Sovereign 3.6  
Jaguar XJS 3.6 Coupe, Convertible

- \* ABS with 4 wheel-speed sensors and 3 hydraulic channels.
- \* Brake-circuit arrangement on axle basis.
- \* Sensor ring gears with 48 teeth.
- \* Wheel-speed-sensor test:

The non-disconnectable differential lock means that the wheels at the rear axle cannot be turned by hand or only with great difficulty.

Caution:  
Do not drive rear axle with brake dynamometer for wheel-speed-sensor testing.

Jack up vehicle, move selector lever to N and let engine run. Both wheels of rear axle turn. Set switch for wheel selection on ABS2 LED-tester to wheel to be tested. After testing the wheel-speed sensors, they must be checked for possible mix-ups whilst the vehicle is still jacked up.

Mix-up test:  
Consecutively move wheels at rear axle back and forth by hand as far as they will go and observe indication on tester. LED flickers or pointer deflects slightly.



## SPECIAL FEATURES (CONTINUED)

Ground-short test for rear-axle wheel-speed-sensor leads:

The rear axle of these vehicles is rubber-cushioned.

There is thus no electrical connection between bodywork ground and rear-axle ground.

When performing ground-short test on wheel-speed-sensor leads for rear axle one prod of the ohmmeter is therefore to be connected to the rear axle and not to the body.

## STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

### ATTENTION :

The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

## SAFETY AND PRECAUTIONARY MEASURES

\*For reasons of safety, the hydraulic modulator must not be repaired, but may be exchanged only as a complete unit.

Exception: relays

\*Do not loosen any screws on the hydraulic modulator! Danger of fatal accident owing to failure of the brakes.

\*Take great care when handling brake fluid. Poison!

For further information, see brief instructions.

## TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- \* Regulatory tire size fitted?
- \* Check for firm seating of ground of return-supply pump.
- \* Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- \* Check for firm seating of ground strap between engine block and vehicle frame.
- \* Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- \* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- \* If the ABS warning lamp lights up constantly and does not go out, check the following points:
  - Controller plug sitting correctly on controller and latched?
  - All plug contacts O.K.?
  - Spring contacts latched?
  - Check installation position for correct seating of seal ring in controller plug, rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

### Wheel-speed sensors:

front left to term. 6 and term. 4.  
front right to term. 11 and term. 21.  
rear left to term. 8 and term. 9.  
rear right to term. 24 and term. 26.  
rear axle to term. — and term. —.

- V-belt snapped?  
(Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).
- \* Connect ABS 2 LED tester to ABS wiring harness.
- Disconnect and connect controller only with ignition switched off.
- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- Observe LED (green) for current supply in all program-selector-switch positions.

## C A U T I O N !

Do not drive with tester connected!

The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.

Repeat the complete test program after any repairs are carried out.

The Antiskid System is a vehicle safety system.

Work on the system demands detailed knowledge of the system.

The conventional brake system must be O.K.

### General information for trouble-shooting:

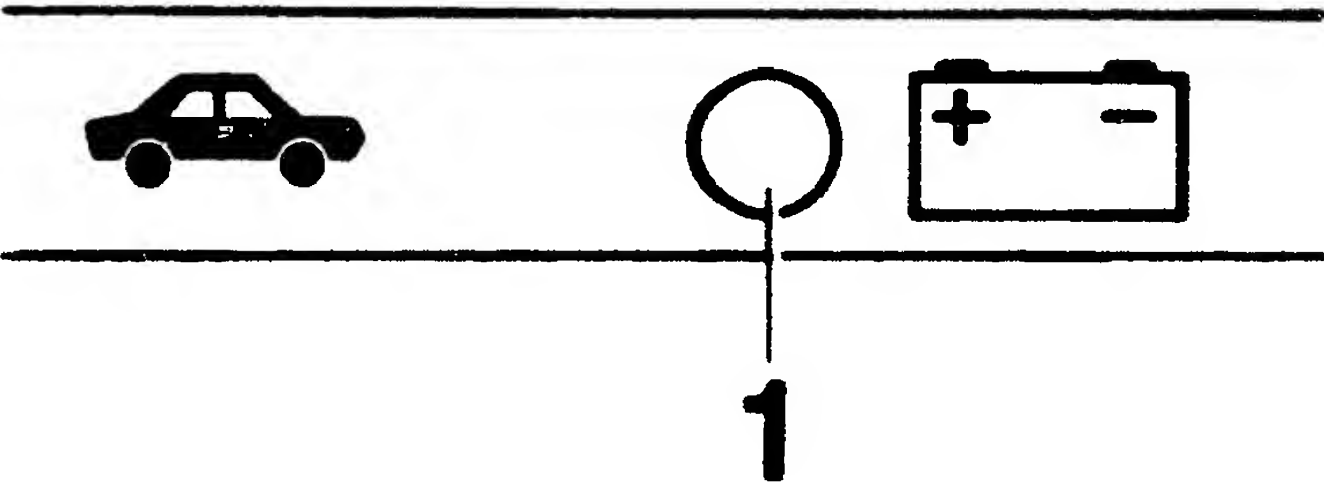
Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

RAPID DIAGNOSIS CHART

Never drive with tester connected! Have all test prerequisites been met?

Program-selector-switch positions 1 - 6

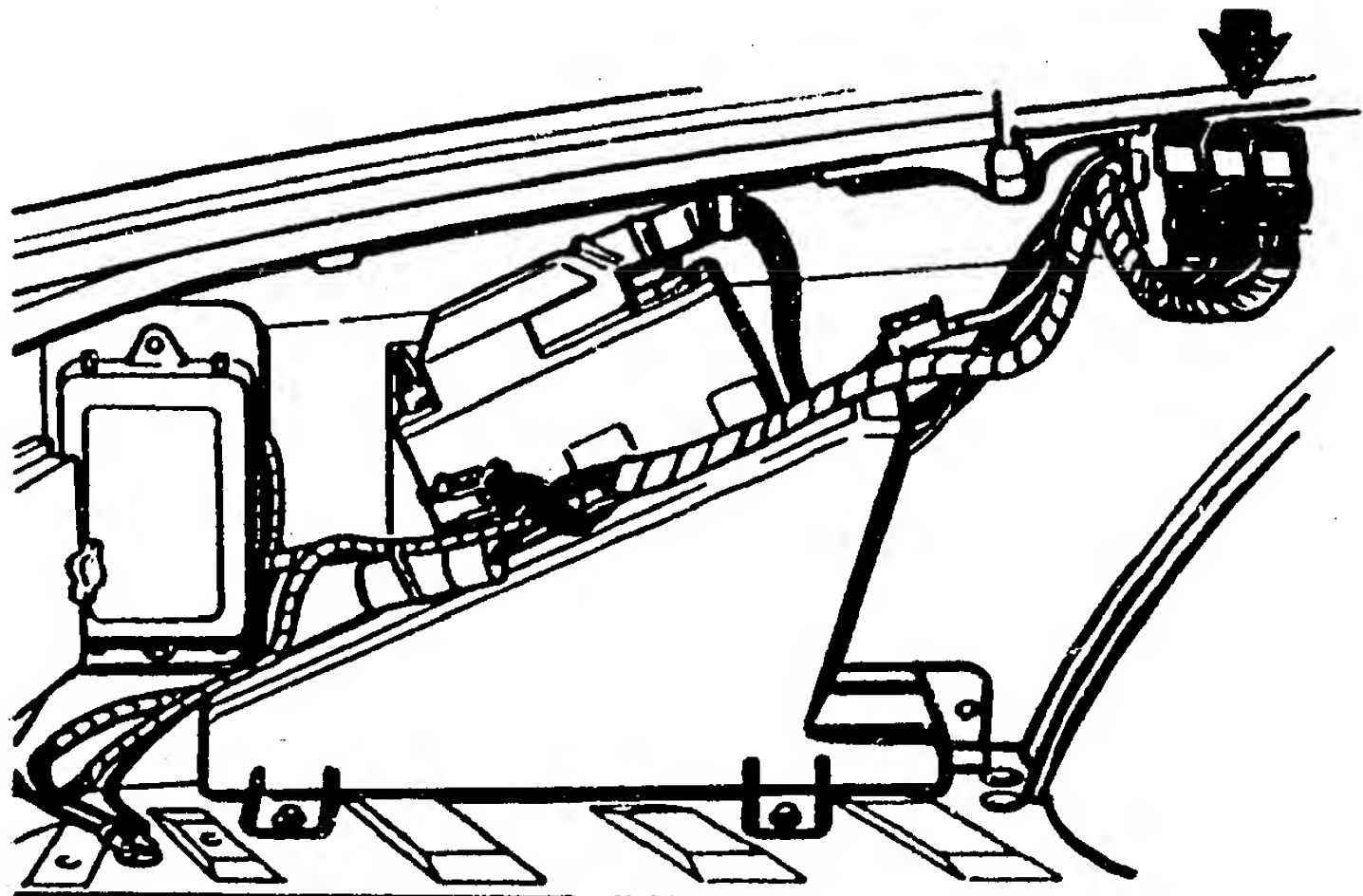
Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of trouble
Voltage supply  (Term.1 and term.20)	Ignition on	LED 1 (Top picture) lights up constantly	<ul style="list-style-type: none"><li>* Battery not sufficiently charged</li><li>* Excessive voltage dips.</li> <li>* Check leads from relay plug to controller term.1, to driving switch term.15, to battery B+ and to ground terminal. Check ground lead to controller term.20.</li> <li>* Over-voltage protection relay defective.</li></ul>



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1 = LED for supply voltage

Arrow = Overvoltage-protection relay



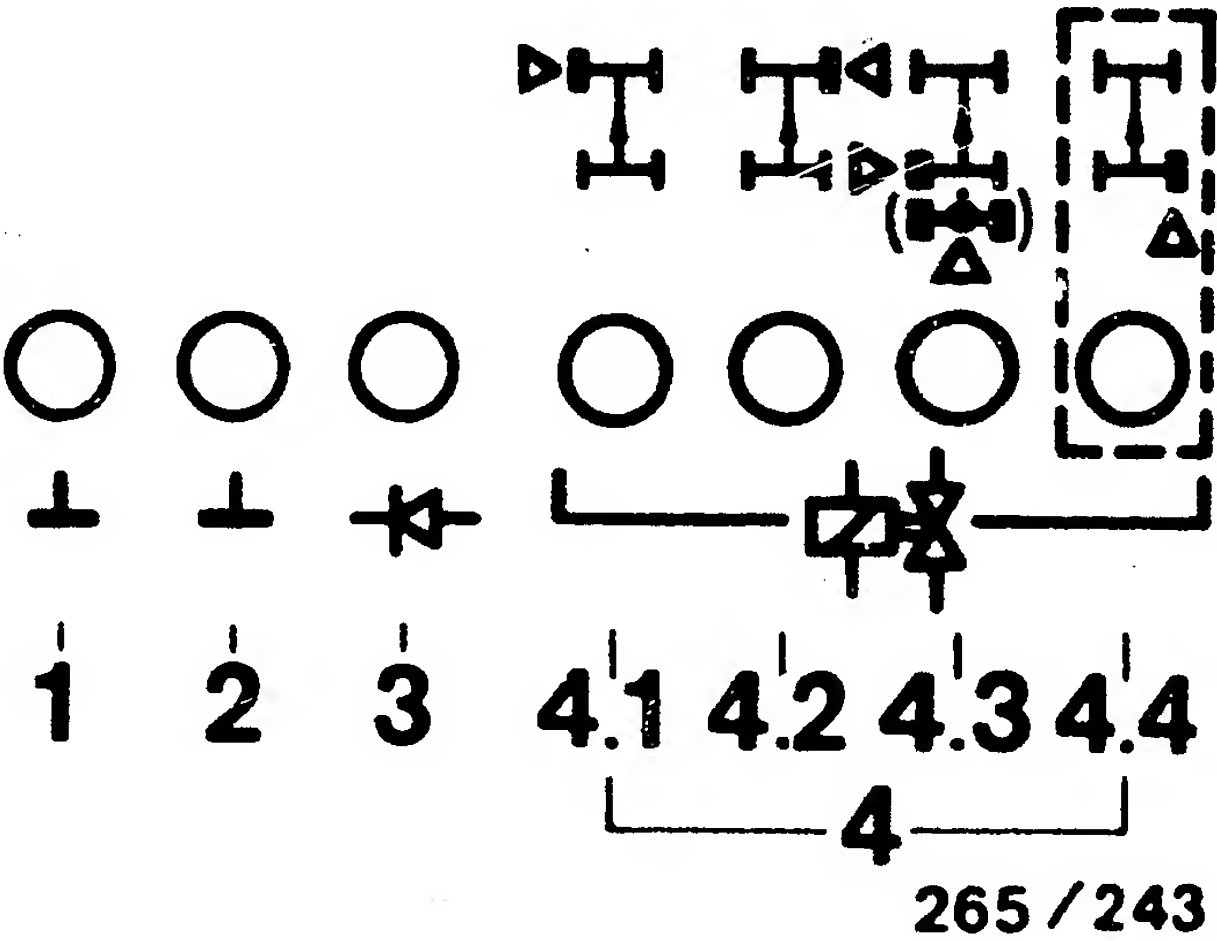
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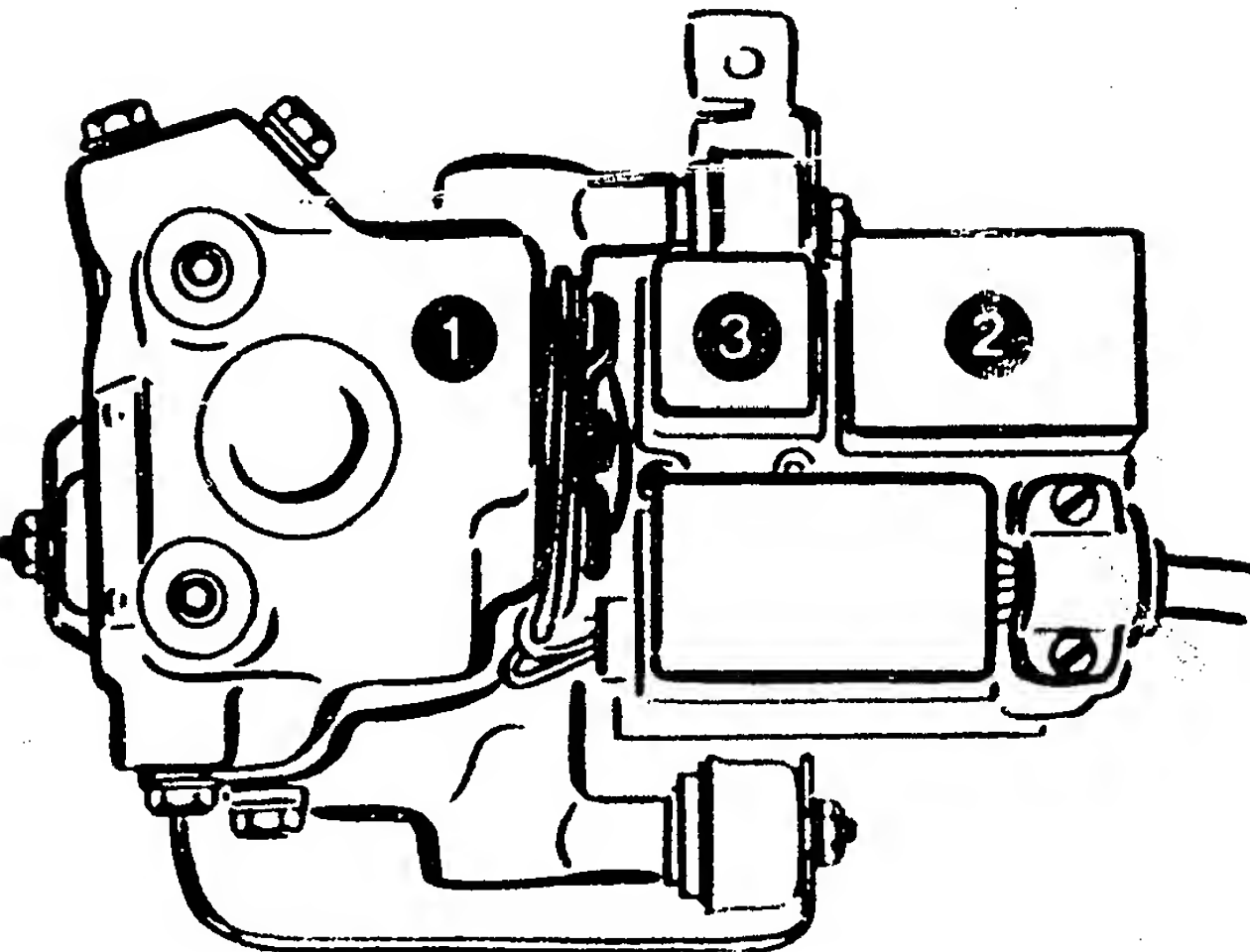
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (3-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34)  Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.35, term.-, term.18)  Off-position and ground connection of relay  ABS warning lamp	Ignition on	6 LED (1 to 4.3)  simultaneously brightly lit (top picture)  ABS warning lamp in vehicle must light up	<ul style="list-style-type: none"><li>* LED 1 and/or 2 (top picture) not lit: Check ground terminals for open circuit.</li><li>* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.</li><li>* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid-operated valve and leads.</li></ul> <p>Solenoid-operated valve internal resistance 0,7...1,7 <math>\Omega</math></p> <ul style="list-style-type: none"><li>* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.</li><li>* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.</li><li>* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.</li></ul>



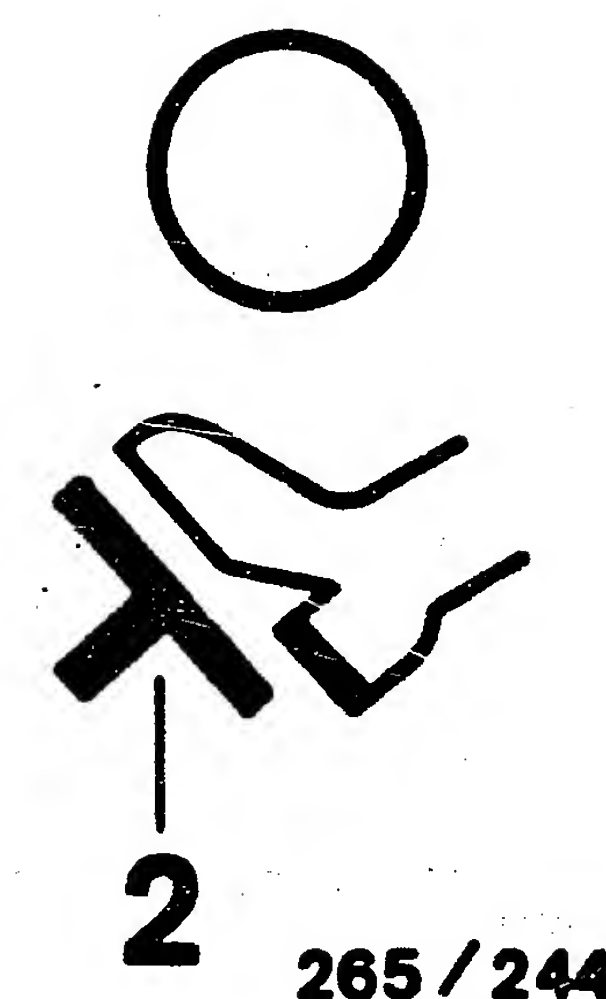
1 = Hydraulic modulator  
2 = Motor relay  
3 = Valve relay



# RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

Under test (Measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61 * Alternator defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective.  * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.

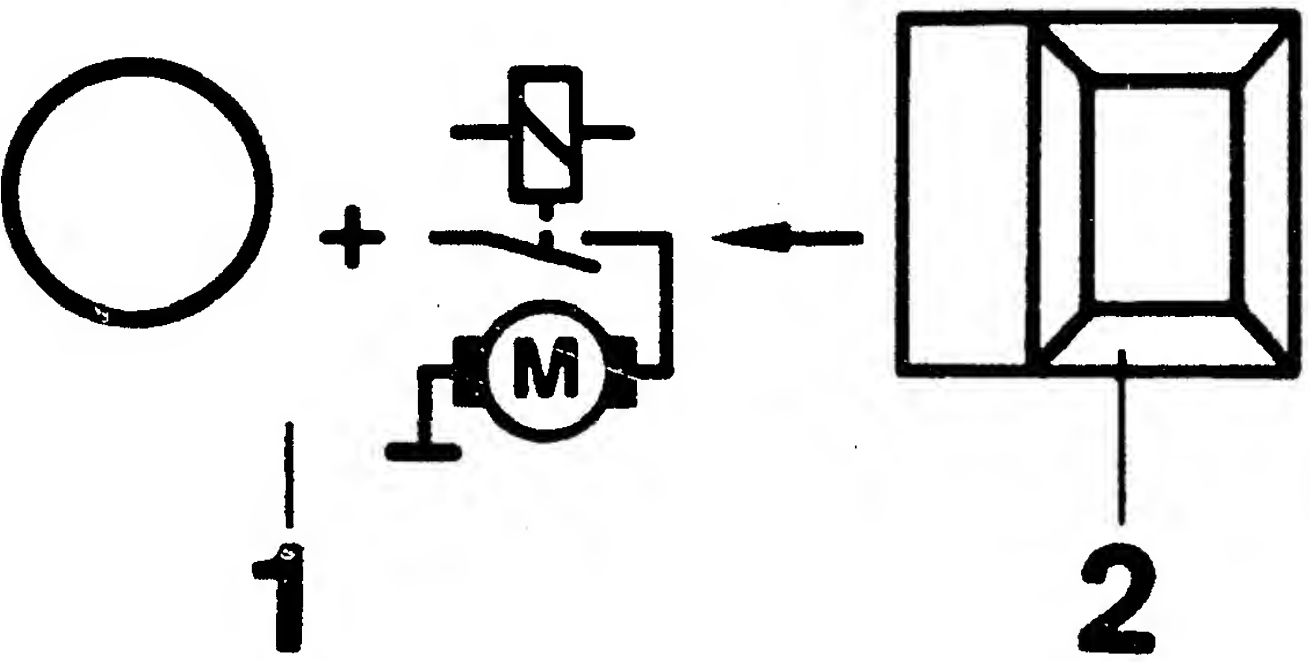




RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 3

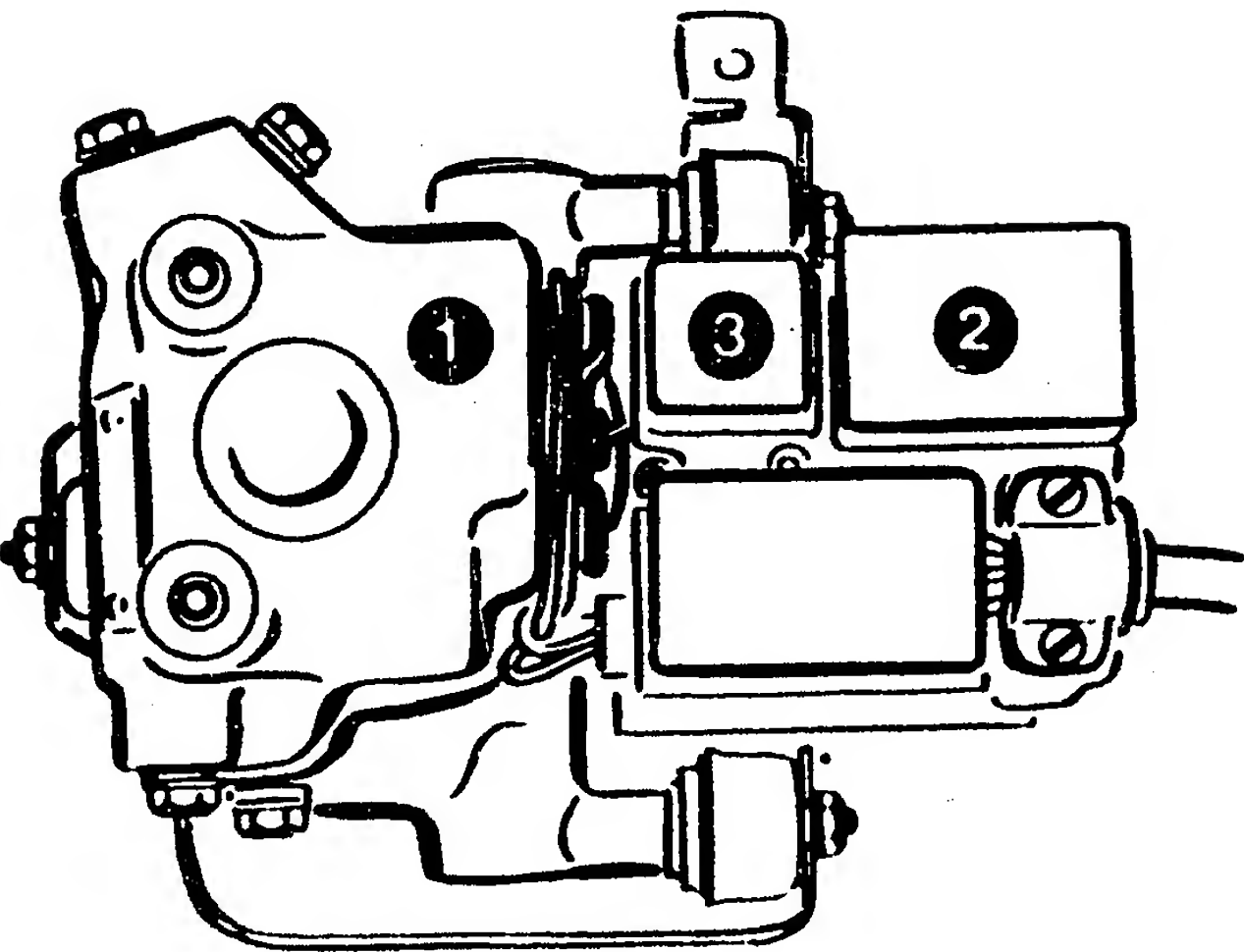
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.14 and term.28)	Ignition on, press button 2 contin- uously (top picture)	LED 1 lights up, pump motor runs.  After releasing button, LED con- tinues to light due to run-on of motor (top picture).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Test ground connection and positive terminal of pump motor</li><li>* Test following leads:  From controller term. 14 and term. 28 to hydraulic modulator term. 9 or term. 11. Positive leads to hydraulic modulator term. 10 and term. 12.</li><li>* Pump motor or hydraulic modulator defective.</li></ul>



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Program-selector-switch position 4 does not apply.

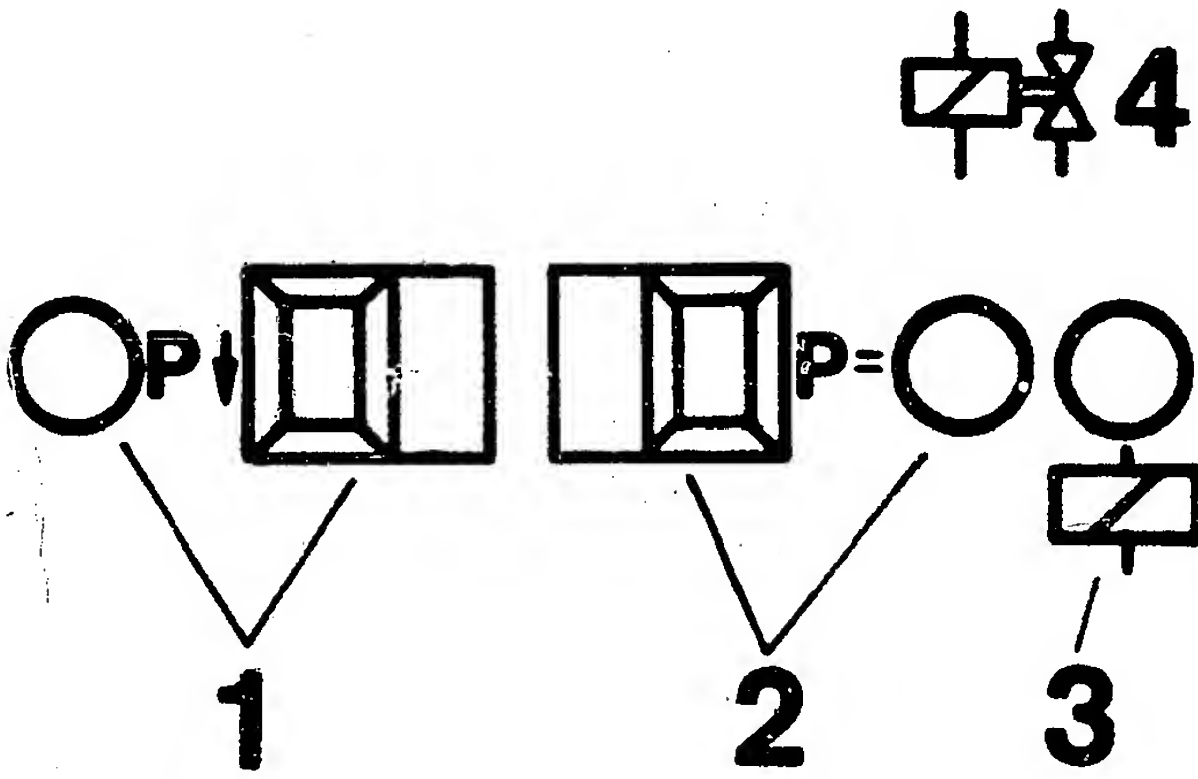
1 = Hydraulic modulator  
2 = Motor relay  
3 = Valve relay



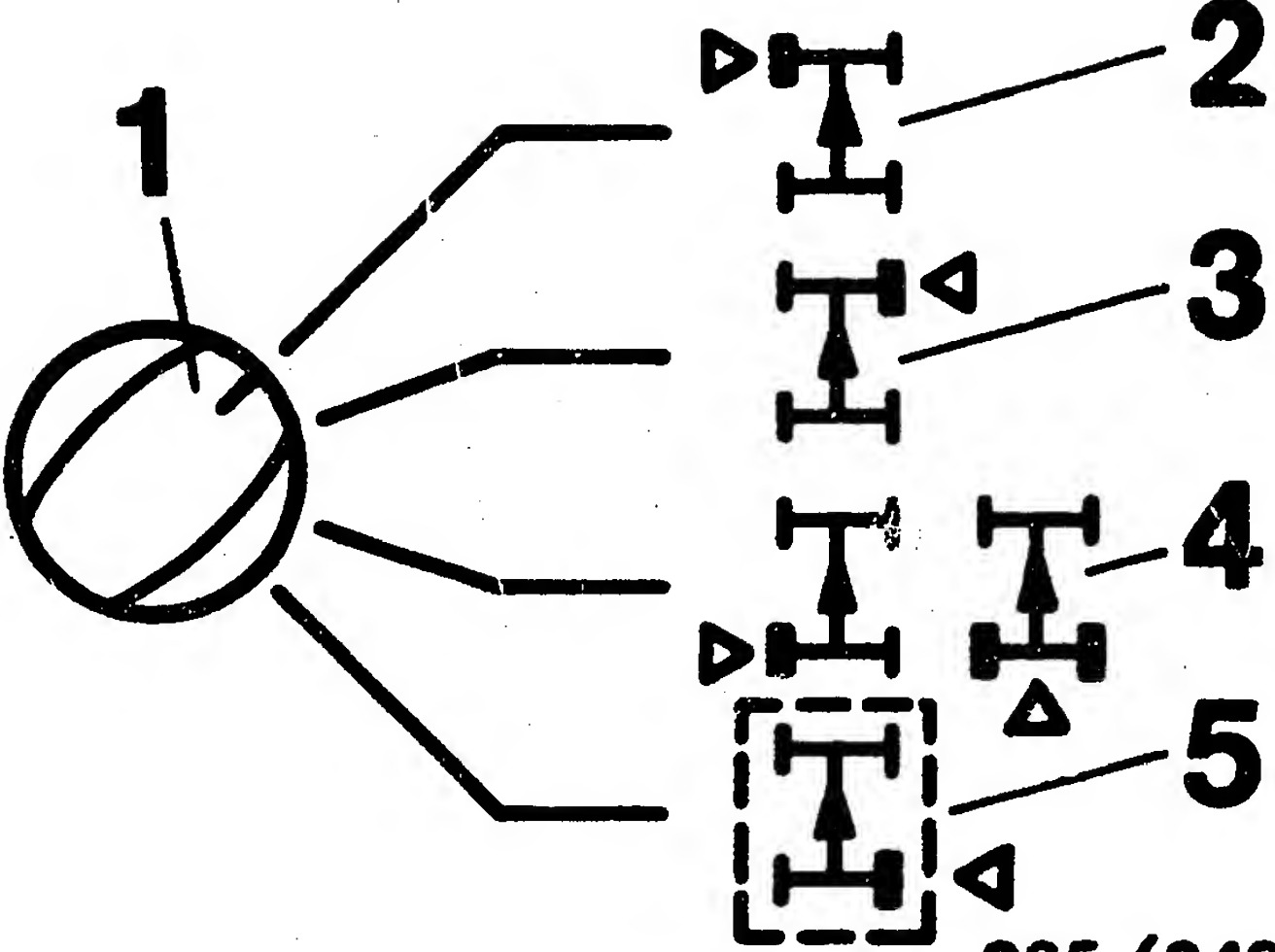
265 / 0211 1

**RAPID DIAGNOSIS CHART (CONTINUED)**  
Program-selector-switch position 5 (3-channel hydraulic modulator)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve-relay operation (term.27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valve in hydraulic modulator for operation and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence!	Choke up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. For the rear axle, set to position 4 (lower illustration).		* Repeat test with engine running  * Valve relay (make contact) defective  * Break in line from valve relay term. 87 to batt. +ve  * Brake leads at hydraulic modulator mixed up
Operation pressure holding	1. Constantly press push-button P= (lower illus.)	LED P= (lower illus.) lights up	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly depress brake pedal	Wheel turnable by hand	
	3. Release push-button P= (upper illustration)	LED P= goes out (upper illus.) Wheel locks	
Operation pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-op. valves correctly connected electrically? Wheel, front left: term. 2 Wheel, front right: term.35 Wheel, rear left: term.— Wheel, rear right: term.— Rear axle: term.18  * Hydraulic modulator defective
	5. Release push-button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6. Release brake pedal		



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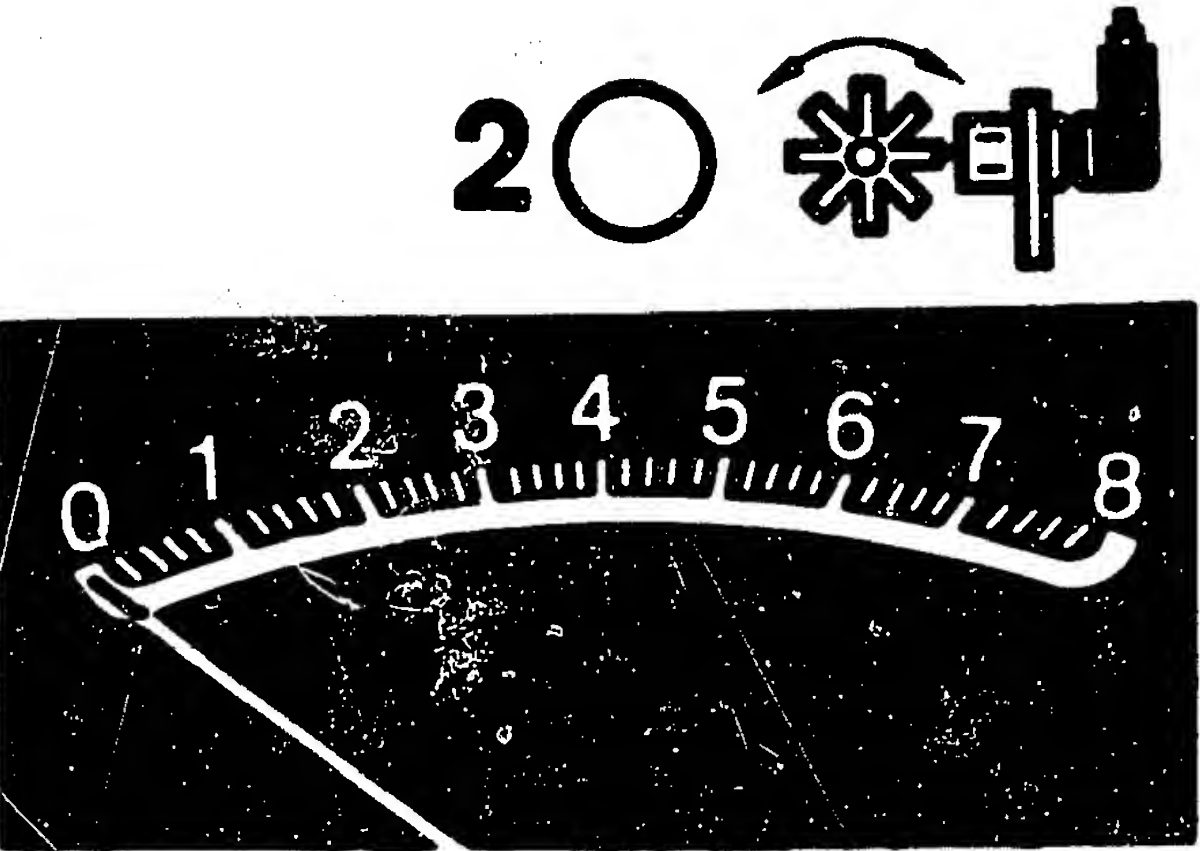
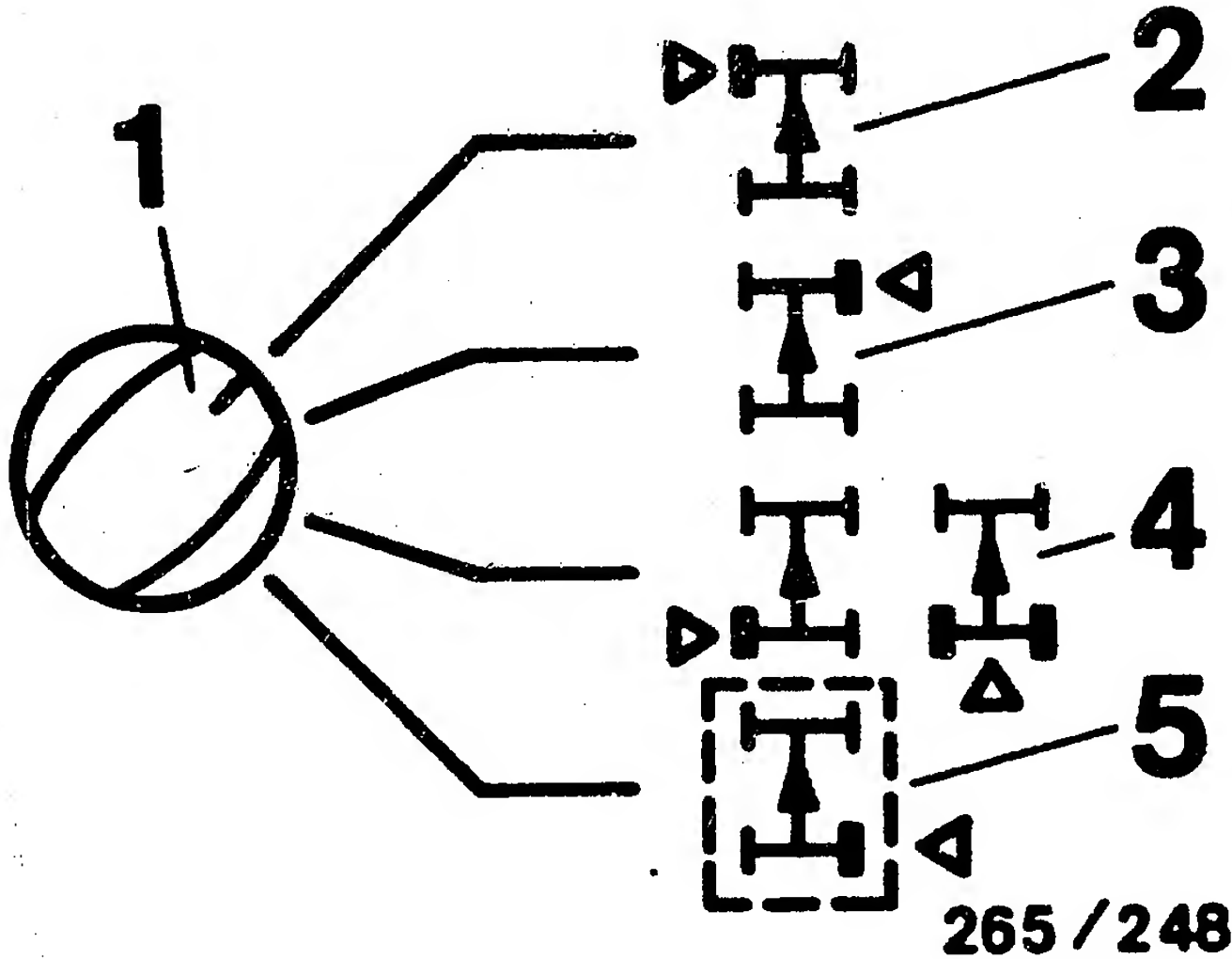
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RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensor)

Testing of (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
<p>Wheel-speed sensor for proper functioning and mix-up</p> <p>NOTE: Perform test consecutively for each individual wheel</p> <p>IMPORTANT: When testing wheel-speed sensors on rear axle, refer to "Special features"; wheels cannot be turned by hand on account of differ- ential lock. Atten- tion is to be paid to special ground- short test for rear axle wheel- speed-sensor leads.</p> <p>Wheel, front left: term. 6 and term. 4</p> <p>Wheel, front right: term. 11 and 21</p> <p>Wheel, rear left: term. 8 and term. 9</p> <p>Wheel, rear right: term. 24 and 26</p>	<p>Jack up vehicle. Ignition on.</p> <p>It must be possible to turn the wheel to be tested freely by hand.</p> <p>When testing the driven axle, the wheel not being tested must be held.</p> <p>Set switch for wheel selection to wheel to be tested (bottom picture)</p> <p>Turn wheel by hand until LED 2 above instrument lights without flickering. (speed approx. 1 revolution per second). Then read off value indicated on instrument: (top picture)</p>	<p>1. Smallest reading greater than 1,6 scale divisions</p> <p>2. Perm. fluctuation band max. 25 % from highest value indicated</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Open circuit in wheel-speed-sensor lead</p> <p>*Wheel-speed sensor defective</p> <p>Winding resistance Front axle: 0,6...1,6 k <math>\Omega</math> Rear axle: 0,6...1,6 k <math>\Omega</math></p> <p>*Air gap between wheel-speed sensor and ring gear too large</p> <p>*Ring gear defective or loose</p> <p>*Ring gear with wrong number of teeth fitted Front axle: 48 teeth Rear axle : 48 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Reading given, LED 2 does not light: Loose contact in wheel-speed- sensor lead.</p>



Continue testing on next Coordinate.

TEST SPECIFICATIONS

Wheel-speed sensor

- \* Winding resistance at ambient temperature (-10°C...+120°C) for front axle:
- rear axle:

600...1600 Ω  
600...1600 Ω

Hydraulic-modulator solenoid-operated valves

- \* Winding resistance at ambient temperature (-10°C...+120°C):

0,7...1,7 Ω

Air gap between wheel-speed sensor and ring gear

- \* at front wheels : slide in wheel-speed sensor as far as it will go
- \* at rear wheels : slide in wheel-speed sensor as far as it will go

Tightening torque for

- \* Fastening screws of the wheel-speed sensors:

> 8 Nm

- \* Brake-line connections on the hydraulic modulator:

12...16 Nm

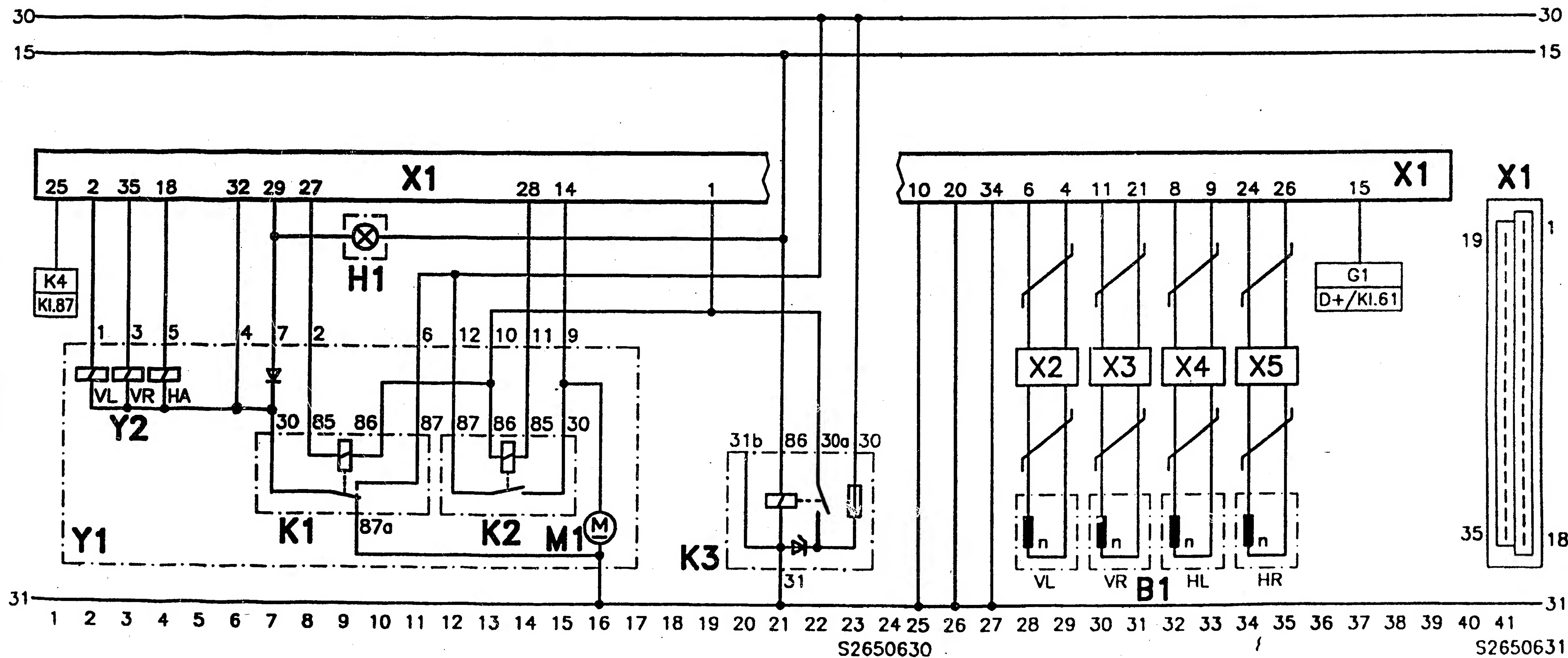
Number of teeth on wheel-speed-sensor ring gears

- \* Front axle:
- \* Rear axle:

48 teeth  
48 teeth

For production reasons:  
continued on the following  
coordinate.





# ELECTRICAL TERMINAL DIAGRAM

B1 = Wheel-speed sensor  
 G1 = to alternator  
 H1 = ABS warning lamp  
 K1 = Valve relay  
 K2 = Motor relay  
 K3 = Over-voltage protection relay  
 K4 = Stop-lamp simulation relay

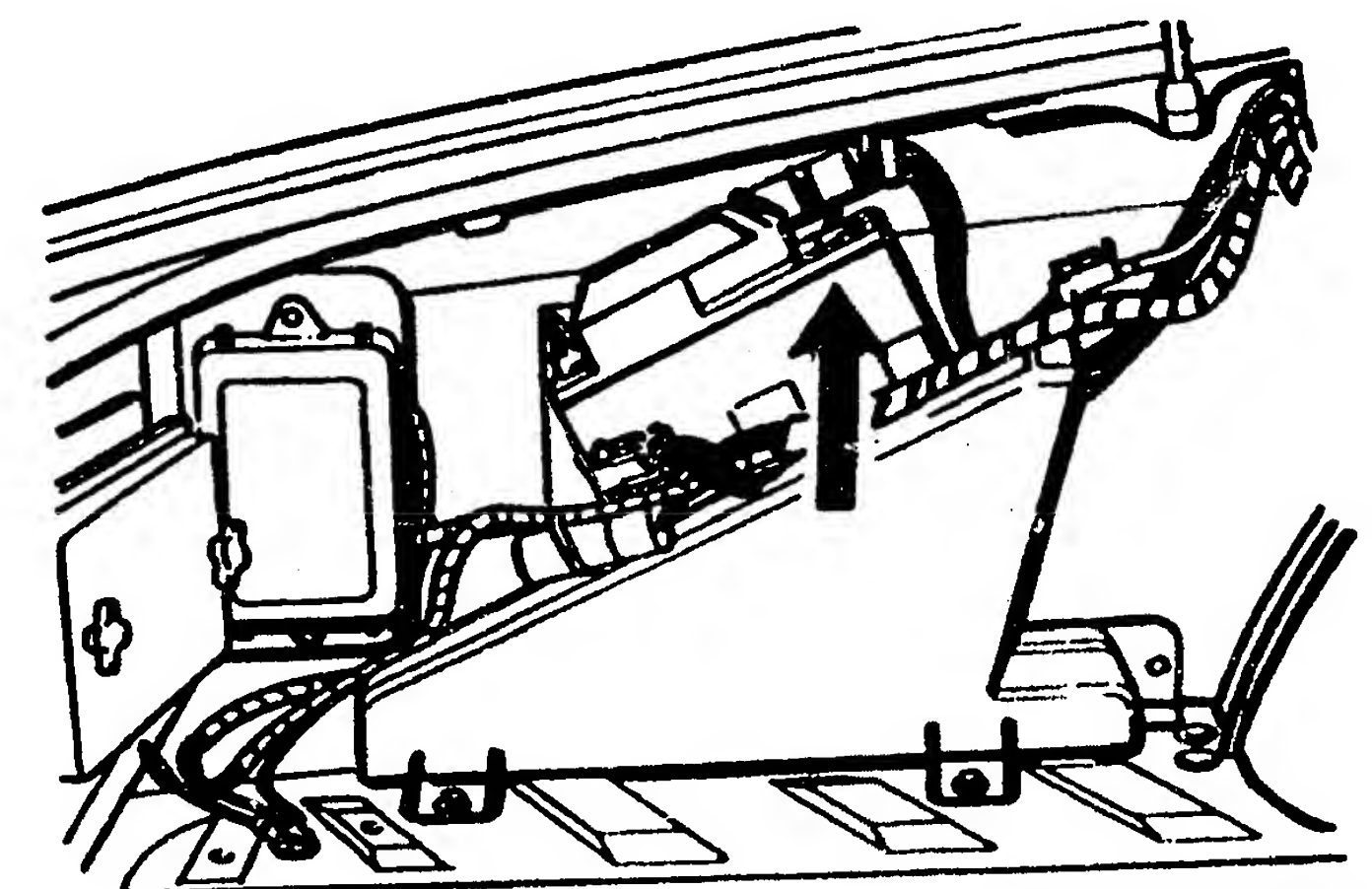
M1 = Return-pump motor  
 S1 = Stop-lamp switch  
 X1 = Controller plug (35-pole)  
 X2...X5 = Multiple butt connector  
 Y1 = Hydraulic modulator  
 Y2 = Solenoid valves

VL = Front left  
 VR = Front right  
 H = Rear axle  
 HL = Rear left  
 HR = Rear right

## INSTALLATION POSITION OF COMPONENTS

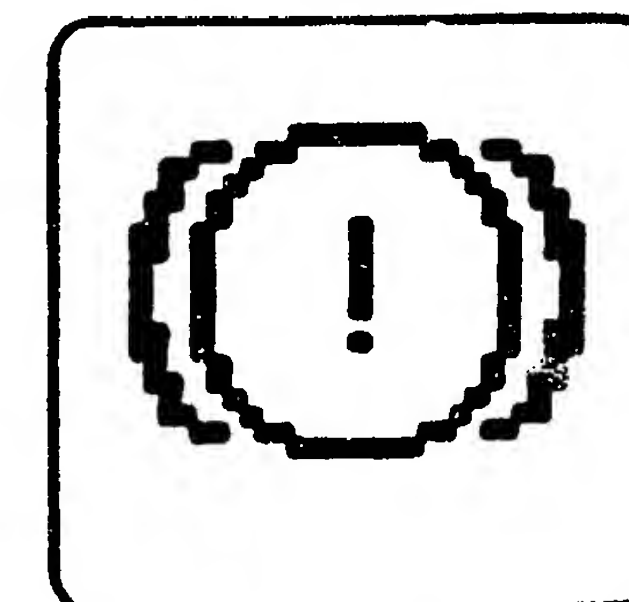
The stated installation locations always refer to the direction of travel.

- \* Controller: arrow, top picture  
In trunk on left-hand side behind trim



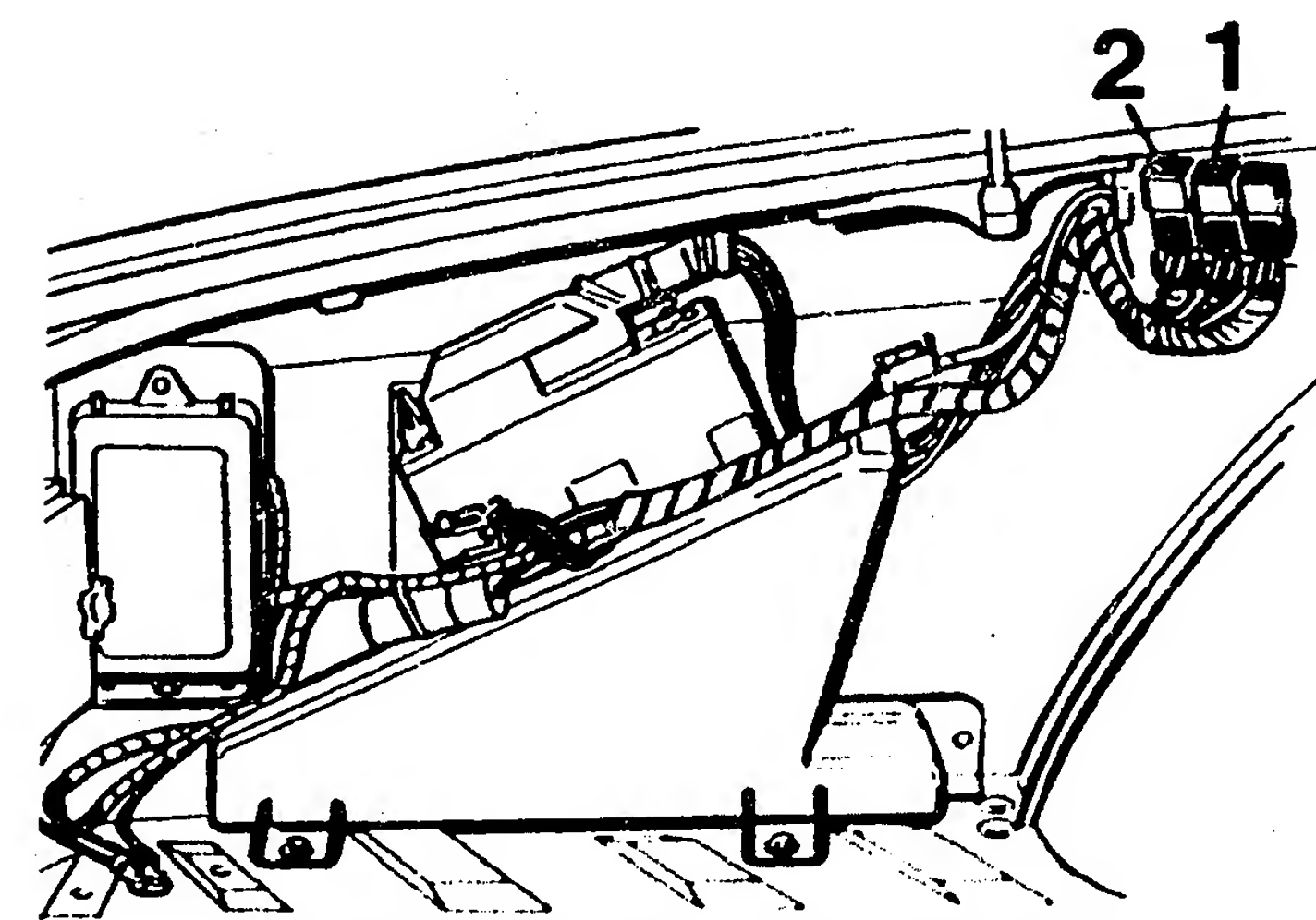
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- \* ABS warning lamp: symbol, center picture  
A symbol with a yellow border and beneath it the words ANTI LOCK FAILURE are displayed on the right-hand side of the instrument panel:



265/0634

- \* Over-voltage protection relay 1 : bottom picture  
Stop-lamp simulation relay 2 : bottom picture  
In trunk on left-hand side above wheel arch.



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## INSTALLATION POSITION OF COMPONENTS (CONTINUED)

### \* Hydraulic modulator: top picture

In engine compartment in direction of travel, right in vicinity of bulkhead.

The hydraulic modulator is not to be repaired, but rather only replaced as a complete unit.  
Exception: relay change.

### \* ABS ground terminal: not illustrated In trunk, left in vicinity of ABS controller.

### \* Wheel-speed sensor, front axle: center picture

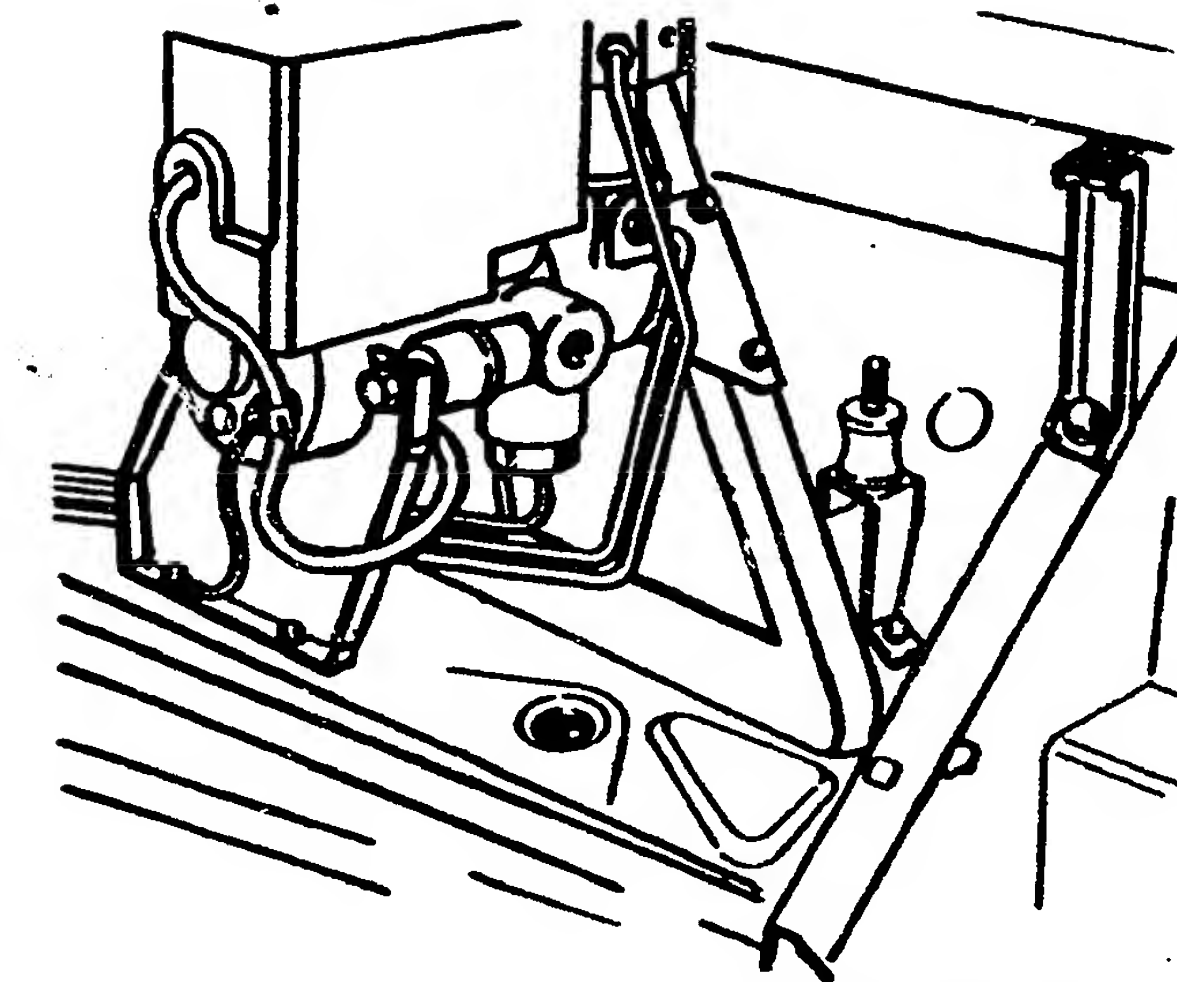
One wheel-speed sensor each on inside (anchor plate) of left and right front wheel.  
Insert wheel-speed sensor as far as it will go into hole, do not knock into position.

Wheel-speed-sensor plug connections:  
In direction of travel, left and right on fender in vicinity of bulkhead.

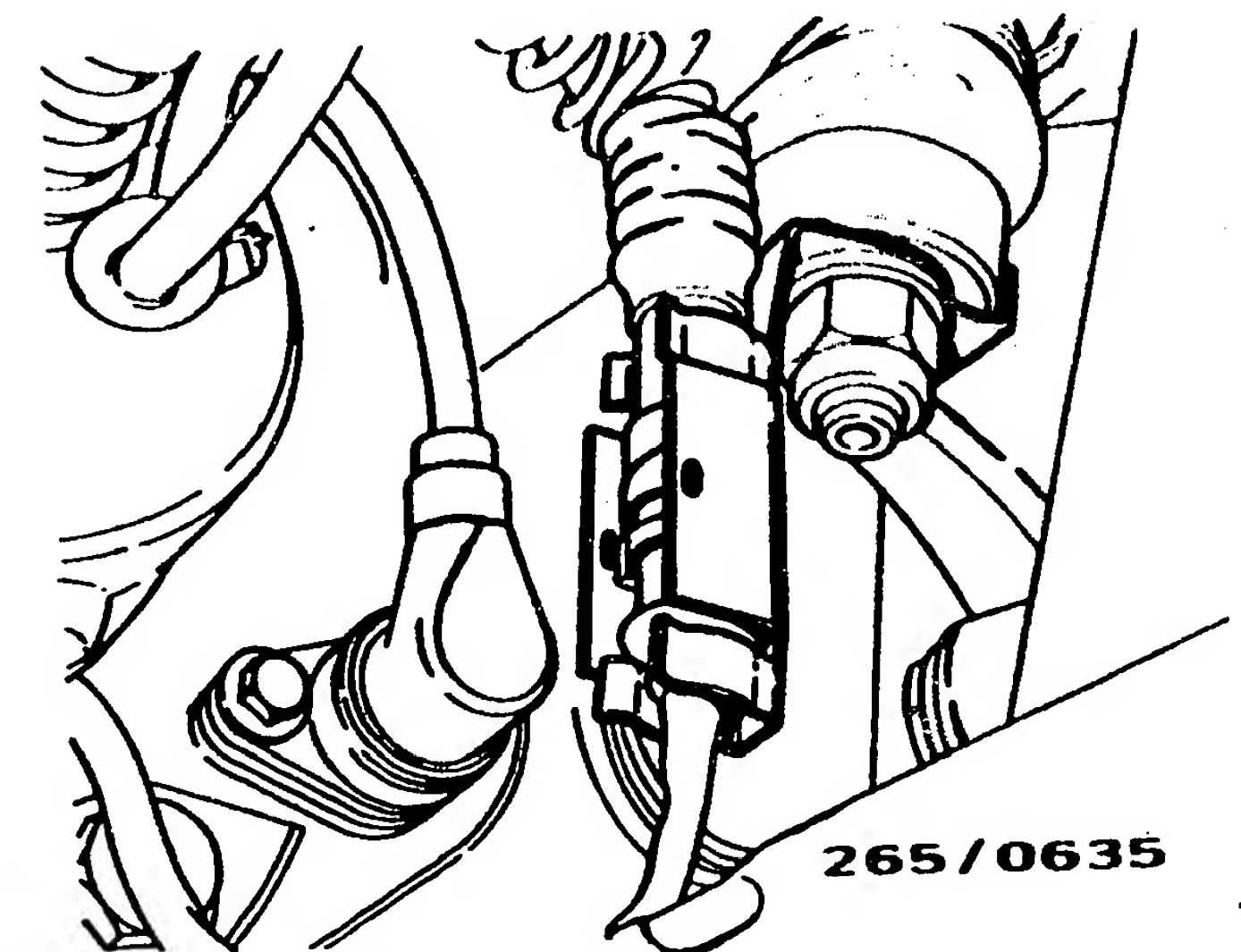
### \* Wheel-speed sensor, rear axle: bottom picture

One wheel-speed sensor each inserted from above into axle beam of left and right rear wheel.  
Insert wheel-speed sensor as far as it will go into hole, do not knock into position.

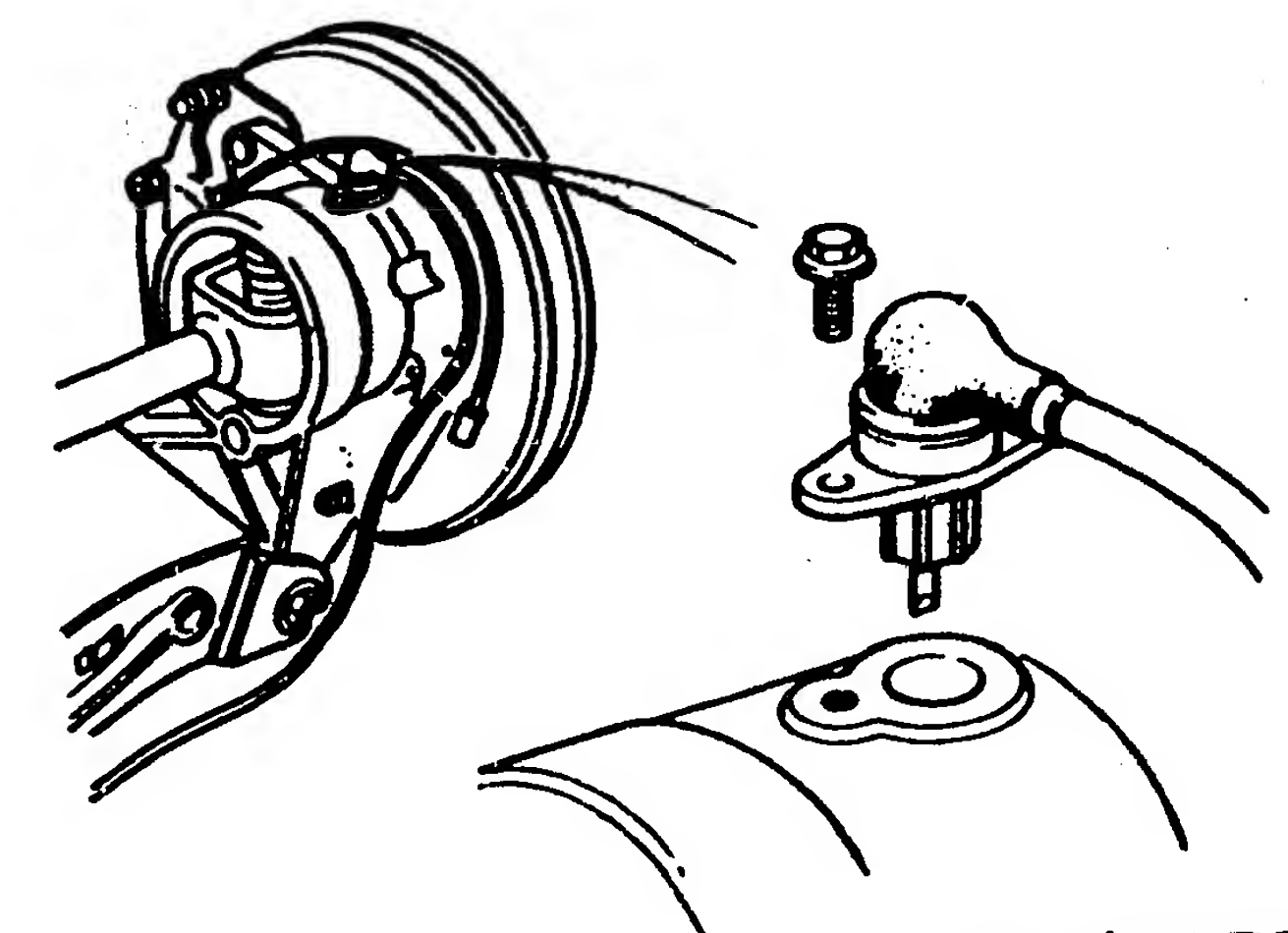
Wheel-speed-sensor plug connections:  
On left and right behind front lining in trunk.



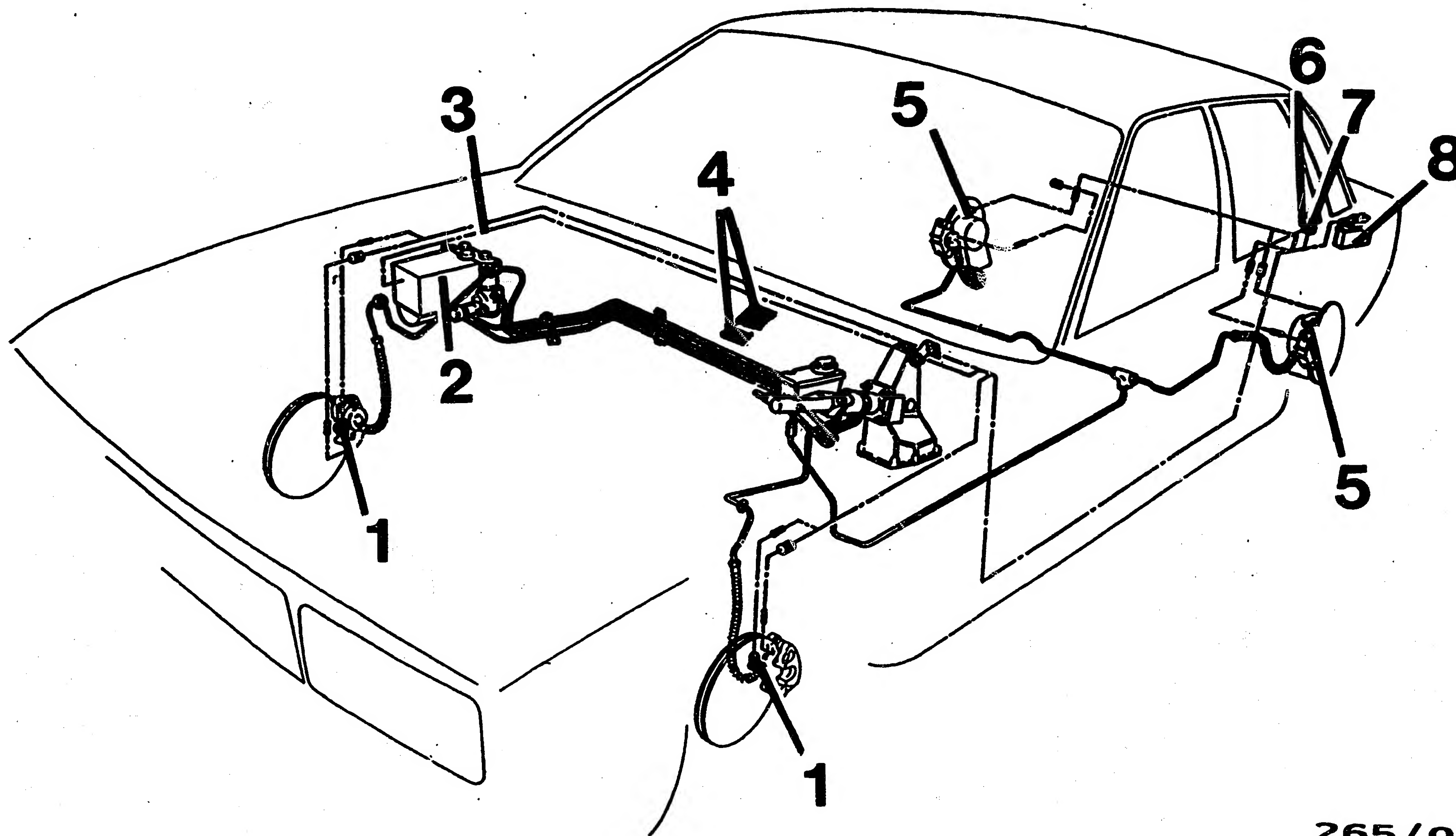
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265/0635



265/0637



265/0639

# INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- 1 = Wheel-speed sensors, front axle
- 2 = Hydraulic modulator
- 3 = ABS wiring harness
- 4 = ABS warning lamp (symbol and text)

- 5 = Wheel-speed sensors, rear axle
- 6 = Over-voltage protection relay
- 7 = Stop-lamp simulation relay
- 8 = ABS controller



BOSCH system	:	ABS
Make of vehicle	:	AUDI
Basic microcard	:	KFZ-00..

Section	Coordinates
Special features .....	02
Structure, usage .....	02
Safety and precautionary measures .....	02
Test prerequisites .....	03
Rapid diagnosis chart .....	05
Differential lock .....	19
Test specifications .....	21
Electrical terminal diagram .....	23
Installation position of components, removal and installation instructions .....	03

This microcard, valid at the time of publication, contains trouble-shooting instructions for the following models:

AUDI 80, 90 quattro  
AUDI 100, 200 quattro  
AUDI quattro  
AUDI 4000, 5000 quattro  
as of approx. 8.86

- \* ABS with 4 wheel-speed sensors and 3 hydraulic channels.
- \* Acceleration sensor (a<sub>L</sub>) as of mid 1987 with the exception of Audi 4000, 5000 quattro

These brief instructions essentially comprise vehicle-specific special features and test specifications (set values).

**A detailed description of trouble-shooting is given in the basic instructions.**

The set values, terminal assignments and special features indicated in these vehicle-specific brief instructions are always binding.

- \* For safety reasons, the hydraulic modulator is not to be repaired, but rather only replaced as a complete assembly.  
Exception: relay.
- \* Do not loosen screws on hydraulic modulator!  
Brake failure may otherwise be fatal.
- \* Take care when handling brake fluid.  
Poisonous!
- \* A limited brake test is permitted, but no performance test.

**Refer to basic instructions for further information.**

## PREREQUISITES FOR TESTING WITH ABS 2-TESTER

- \* Specified tire size fitted?
- \* Test tightness of ground connection of return pump.
- \* Test tightness of ground connection of Combi relay term. 31 and watch out for corrosion.
- \* Test tightness of ground strap between engine block and vehicle frame.
- \* Test hydraulic connections at hydraulic modulator and sealing points for leakage (visual inspection).
- \* If the ABS warning lamp lights up sporadically when driving (e.g. after switching on loads) and goes out again of its own accord, test battery and voltage supply (alternator, regulator and voltage dips).

- \* If ABS warning lamp is constantly lit and does not go out, check following items:

- Is controller plug properly attached to controller and engaged?
- All plug contacts O.K.?
- Spring contacts engaged?
- Check for proper seating of sealing ring in controller plug:  
Curvature downwards.
- Test wheel-speed-sensor leads at controller plug for correct assignment:

### Wheel-speed sensors:

Front left to term. 22 and term. 4.  
Front right to term. 23 and term. 21.  
Rear left to term. 8 and term. 9.  
Rear right to term. 24 and term. 26.  
Rear axle to term. - and term. -.

### Wheel-speed sensor:

on Audi 80, 90, 100, 200 quattro as of approx.  
1.88 front right to term. 11 and term. 21.

- V-belt snapped?  
(No voltage supply from alternator, charge and ABS warning lamp light up).
- \* Connect ABS2-LED tester to ABS wiring harness.
- Only detach and connect controller with ignition switched off.
- For test purposes, switch on ignition in all program-selector-switch settings (tester uses power supply from vehicle battery).
- Observe LED (green) for power supply in all program-selector-switch settings.

## I M P O R T A N T !

Never drive with tester connected!  
Brake system must be bled before performing ABS test. Do not actuate ABS tester during bleeding process.

The entire test program is to be repeated whenever repairs have been performed.  
The ABS is a vehicle safety system.  
Work on this system requires detailed system knowledge.

The conventional brake system must be in proper working order.

### General notes on trouble-shooting:

Test all leads for short-circuit to ground and contact with positive leads as well as for worn insulation and crushing.



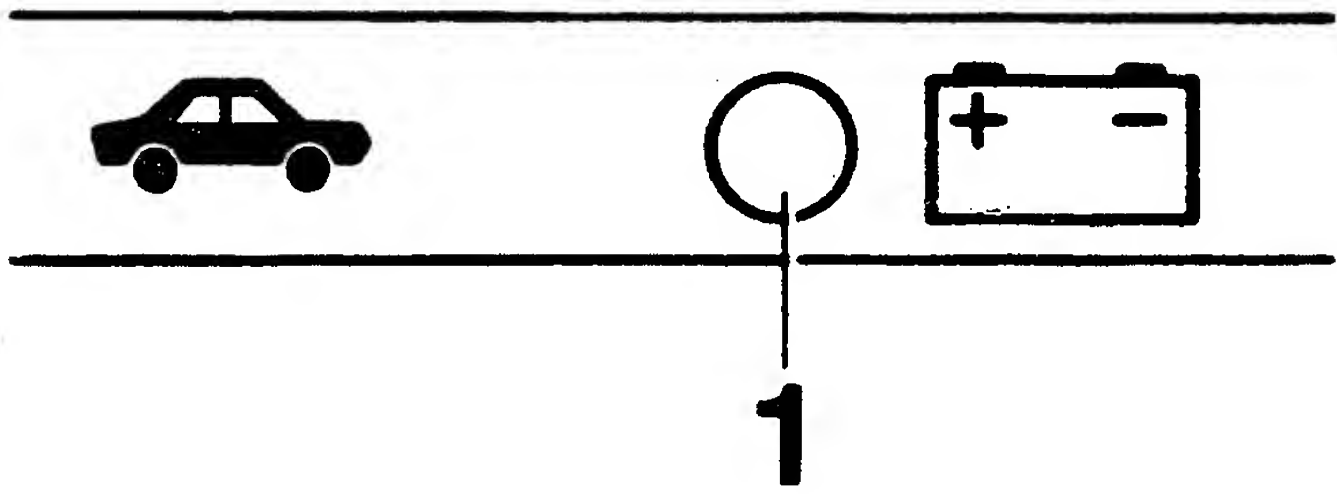
RAPID DIAGNOSIS CHART

Never drive with tester connected! Have all test prerequisites been met?

Program-selector-switch settings 1 to 6

ABS button switched on, lock button switched off

Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Voltage supply  (term. 1 and term. 20)	Ignition on	LED 1 (top picture) lights up all the time	<ul style="list-style-type: none"><li>* Inadequate battery charge</li><li>* Excessive voltage drops</li><li>* Combi relay defective</li><li>* Test lead to driving switch term. 15.</li></ul>

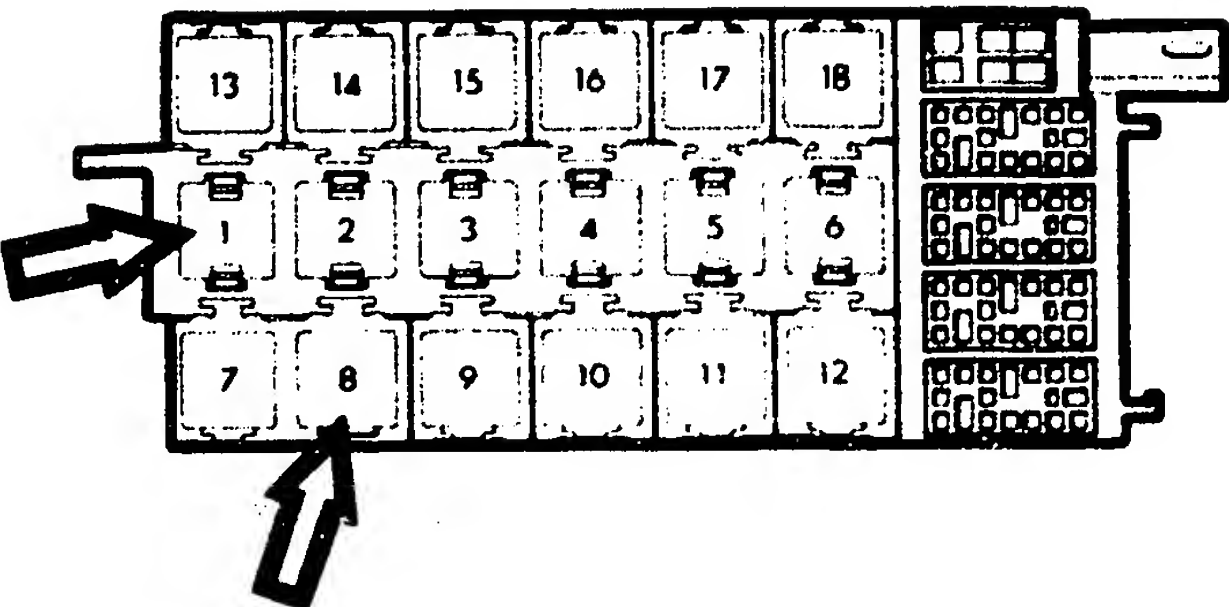


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Arrows = Combi relay in  
auxiliary relay holder

Relay position 1 in  
80/90 quattro

Relay position 8 in 100/200  
quattro

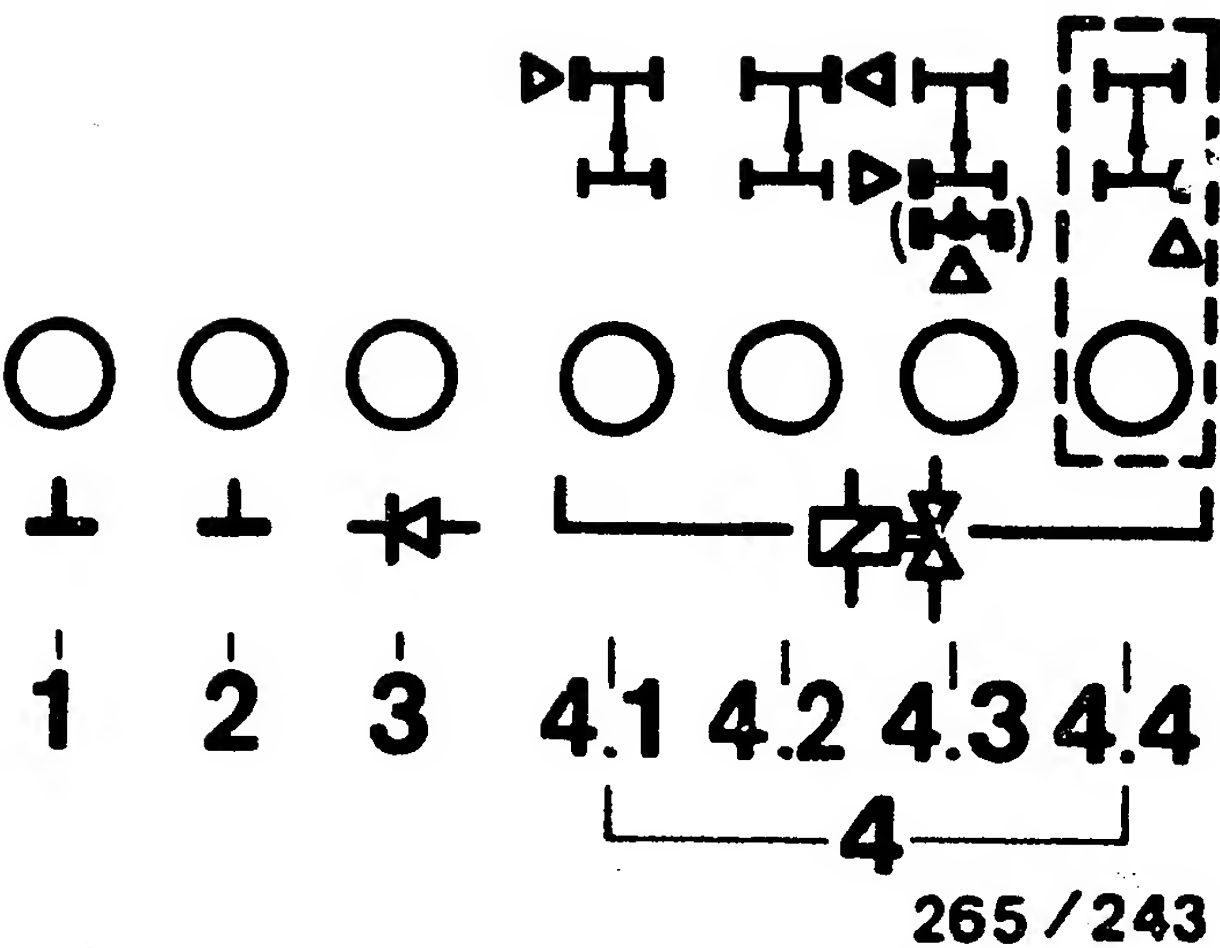


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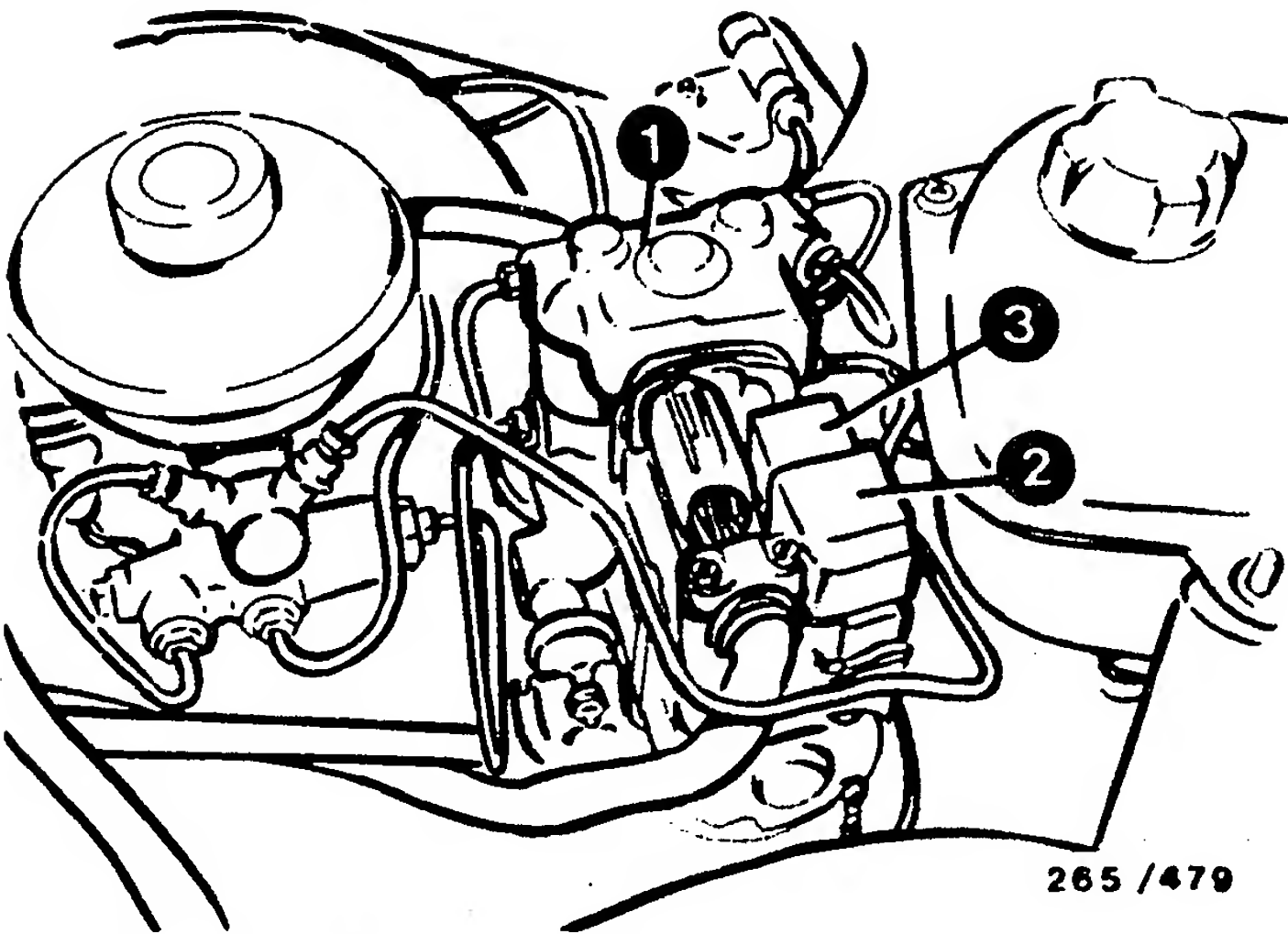
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (3-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34)  Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.-, term.35)  Off-position and ground connection of relay  ABS warning lamp	Ignition on	6 LED (1 to 4.3)  simultaneously brightly lit (top picture)  ABS warning lamp in vehicle must light up	<ul style="list-style-type: none"><li>* LED 1 and/or 2 (top picture) not lit:  Check ground terminals for open circuit.</li><li>* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.</li><li>* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid-operated valve and leads.</li><li>Solenoid-operated valve internal resistance 0,7...1,7 <math>\Omega</math></li><li>* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.</li><li>* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.</li><li>* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.</li></ul>



- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay

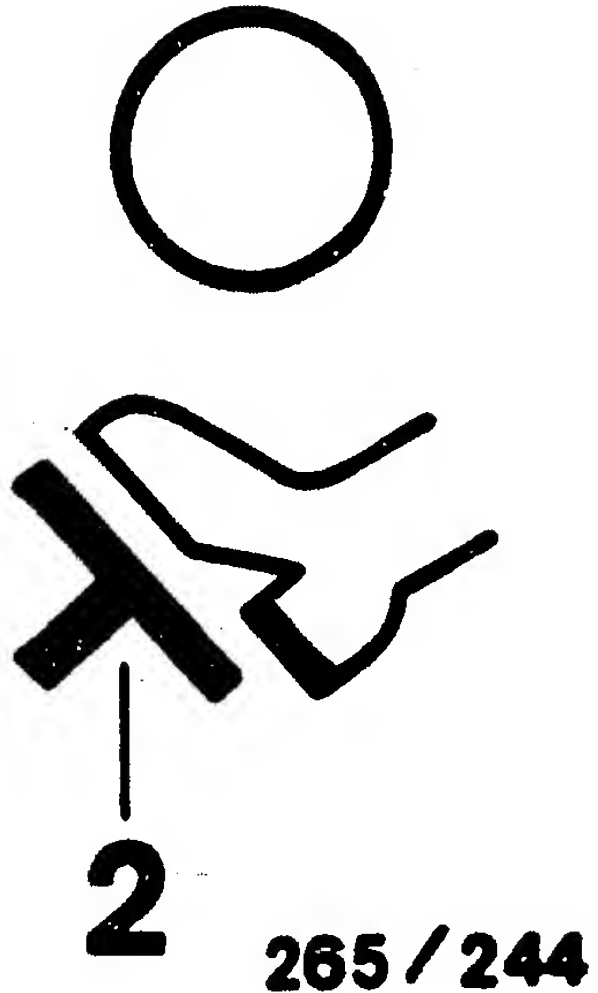




RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

Under test (Measurement at the terminals)	Additional operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61  * Alternator defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective.  * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.

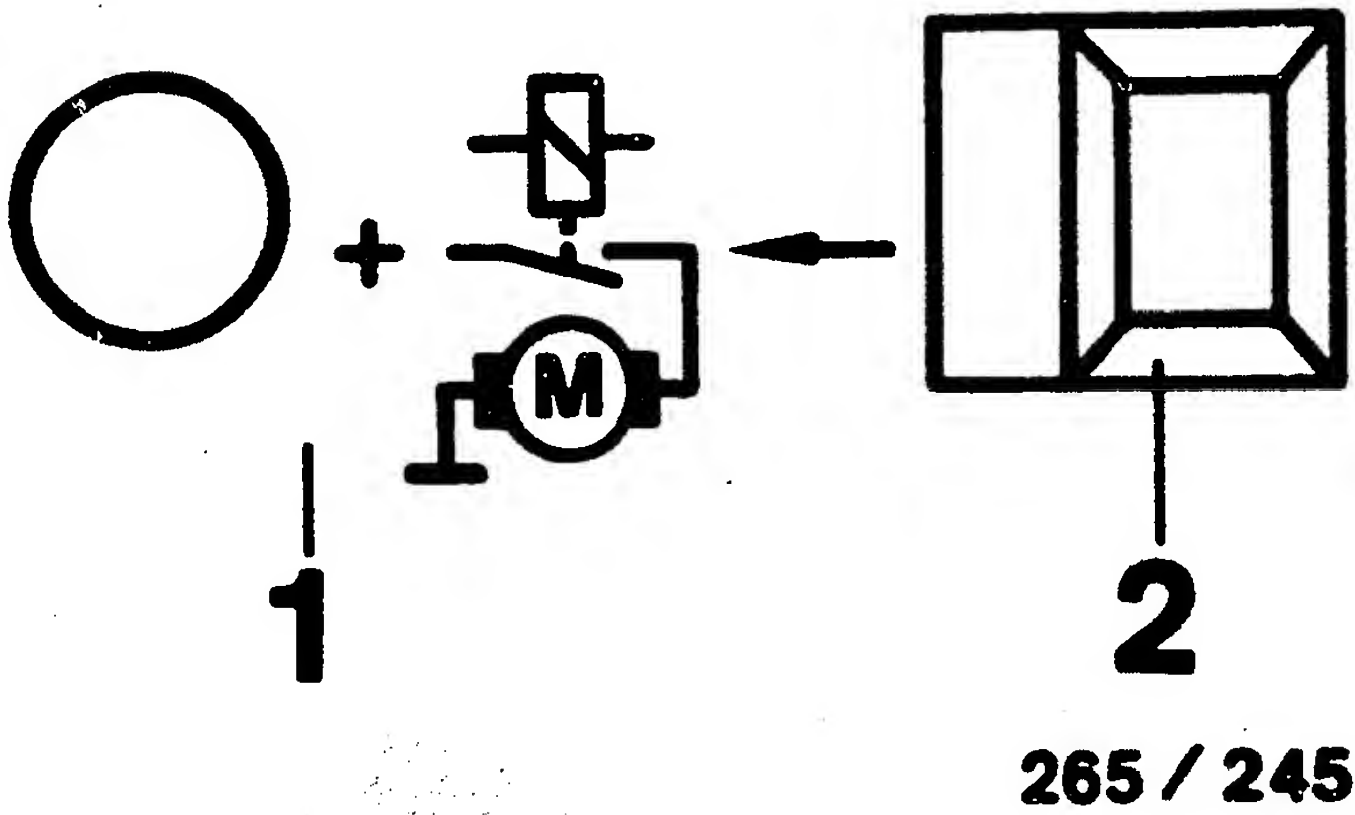


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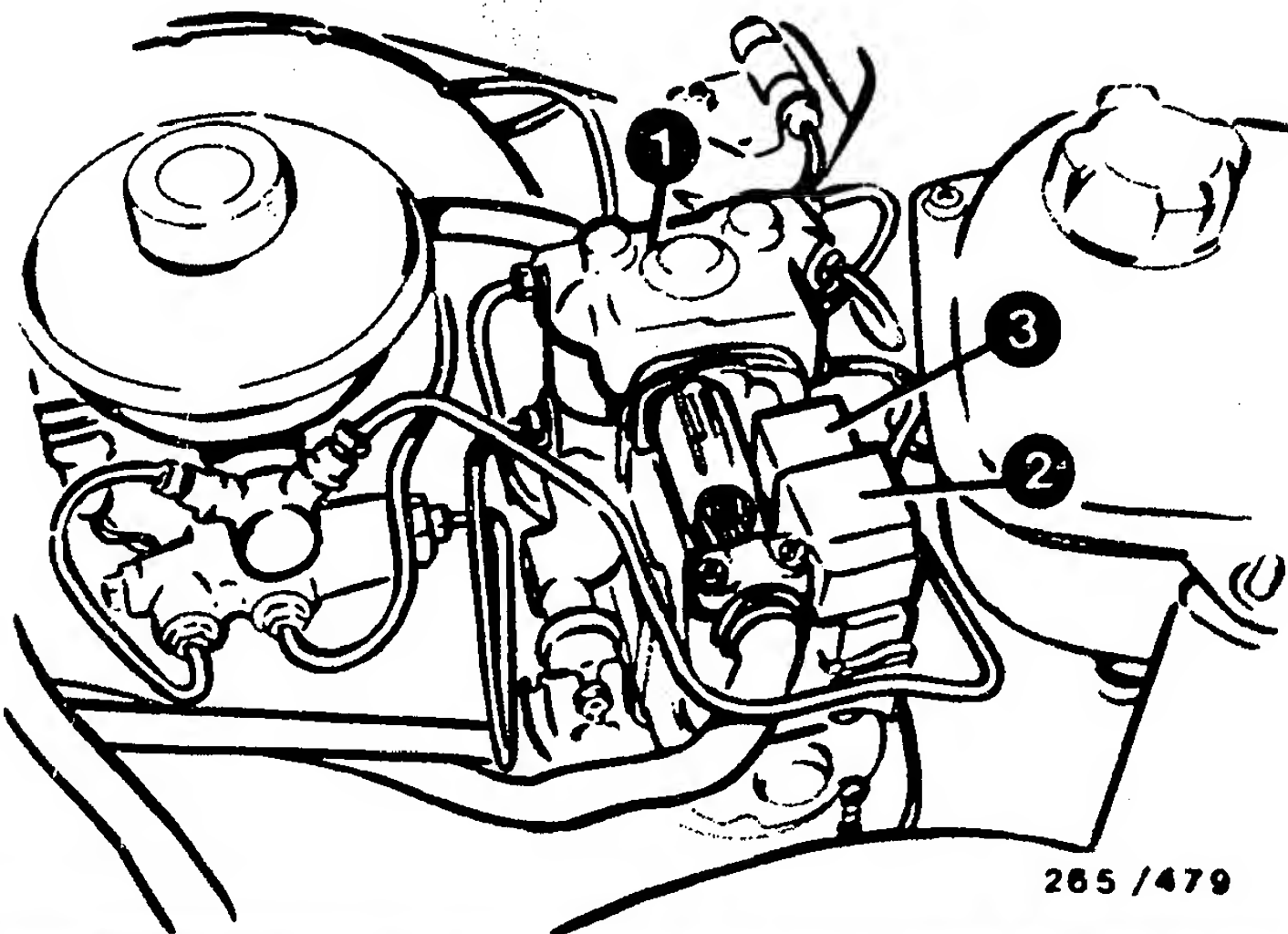
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 3

Testing of (measurement at terminals)	Additional operation	Test specifi- cations (reading)	Possible causes of faults
Motor relay, Pump motor in hydraulic modulator (term.28 and term.14)	Ignition on, Press button 2 continuously (top picture)	LED 1 lit, pump motor running.  After button is released, LED continues to light due to running-on of motor (top picture).	<ul style="list-style-type: none"><li>* Motor relay defective</li><li>* Check ground connection and positive terminal of hydraulic modulator</li><li>* Check leads from controller term.14 and term.28 to hydraulic modulator term.9 and term. 11.</li><li>* Pump motor defective</li></ul>



- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay

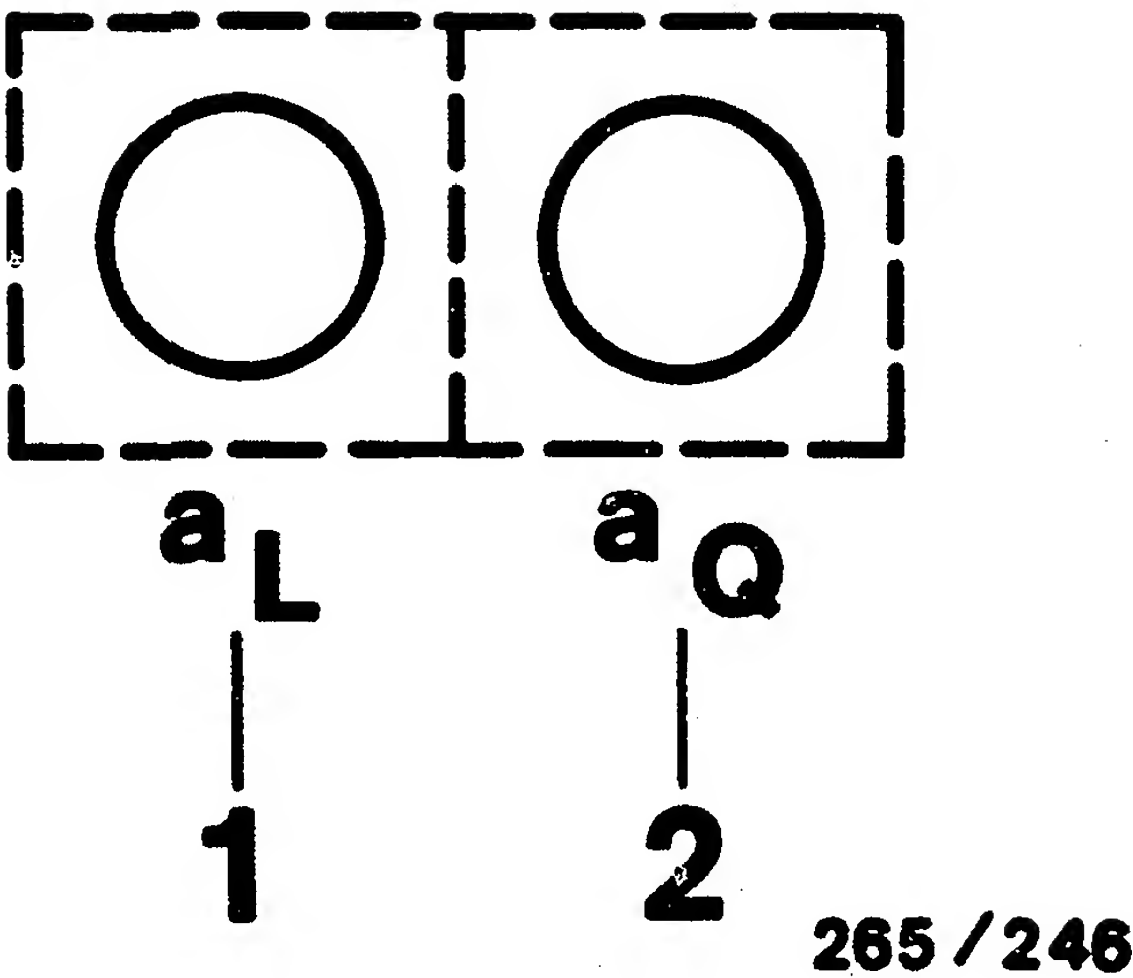


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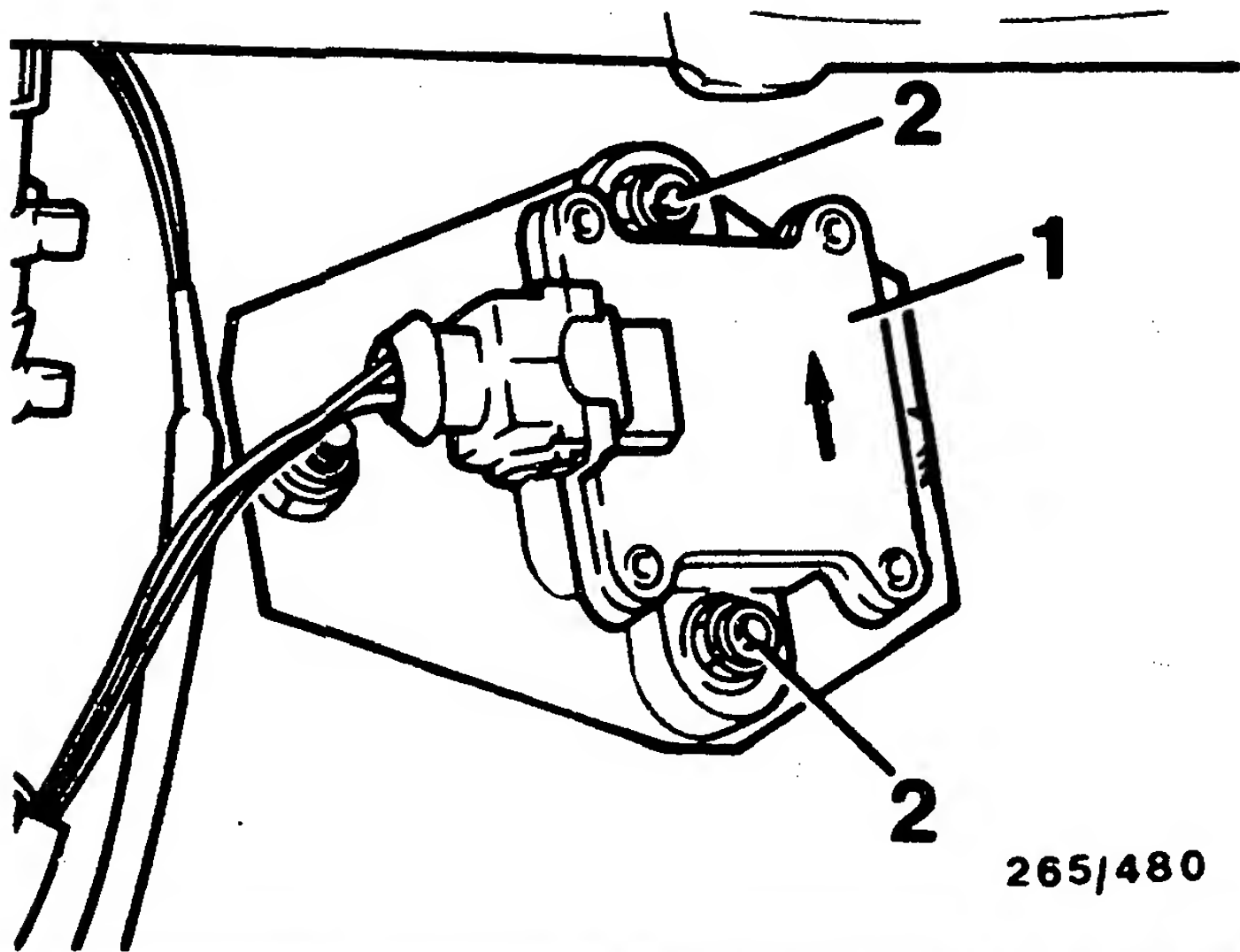
RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch setting 4

Testing of (measurement at terminals)	Add- itional operation	Test specification (indication)	Possible causes of fault
Acceleration sensor a L (term. 16)	Ignition on	LED a L lights up	<ul style="list-style-type: none"><li>* Test acceleration sensor: Resistance: 500...800 Ω Replace sensor: Use self-locking nuts again to attach sensor. Pay attention to installation position. Arrow on sensor must face in direction of travel.</li><li>* Test lead from acceleration sensor to ABS controller term. 16.</li><li>* Test lead from controller term. 1 to acceleration sensor.</li></ul>



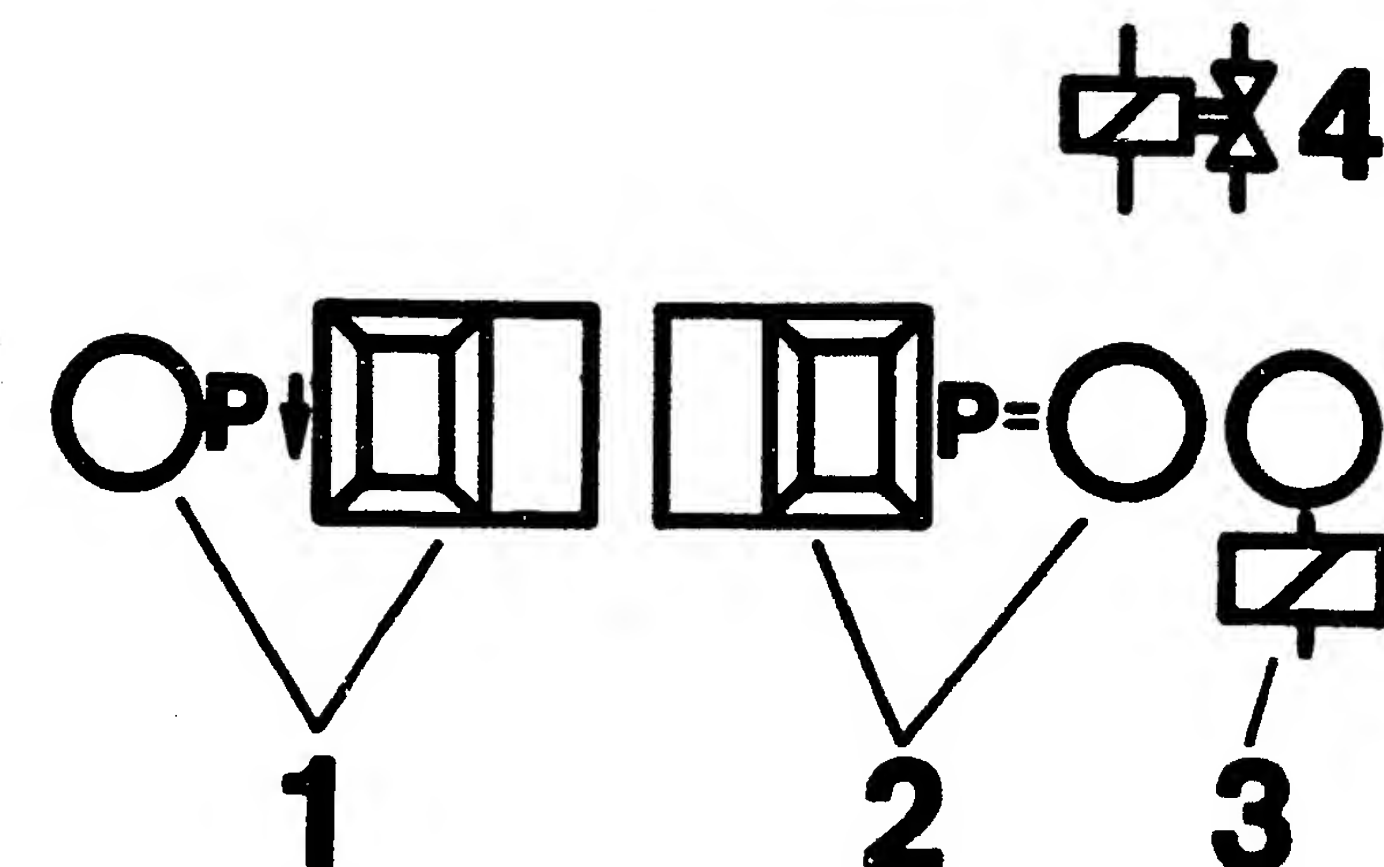
1 = Acceleration sensor  
2 = Self-locking nut  
Arrow = Direction of travel



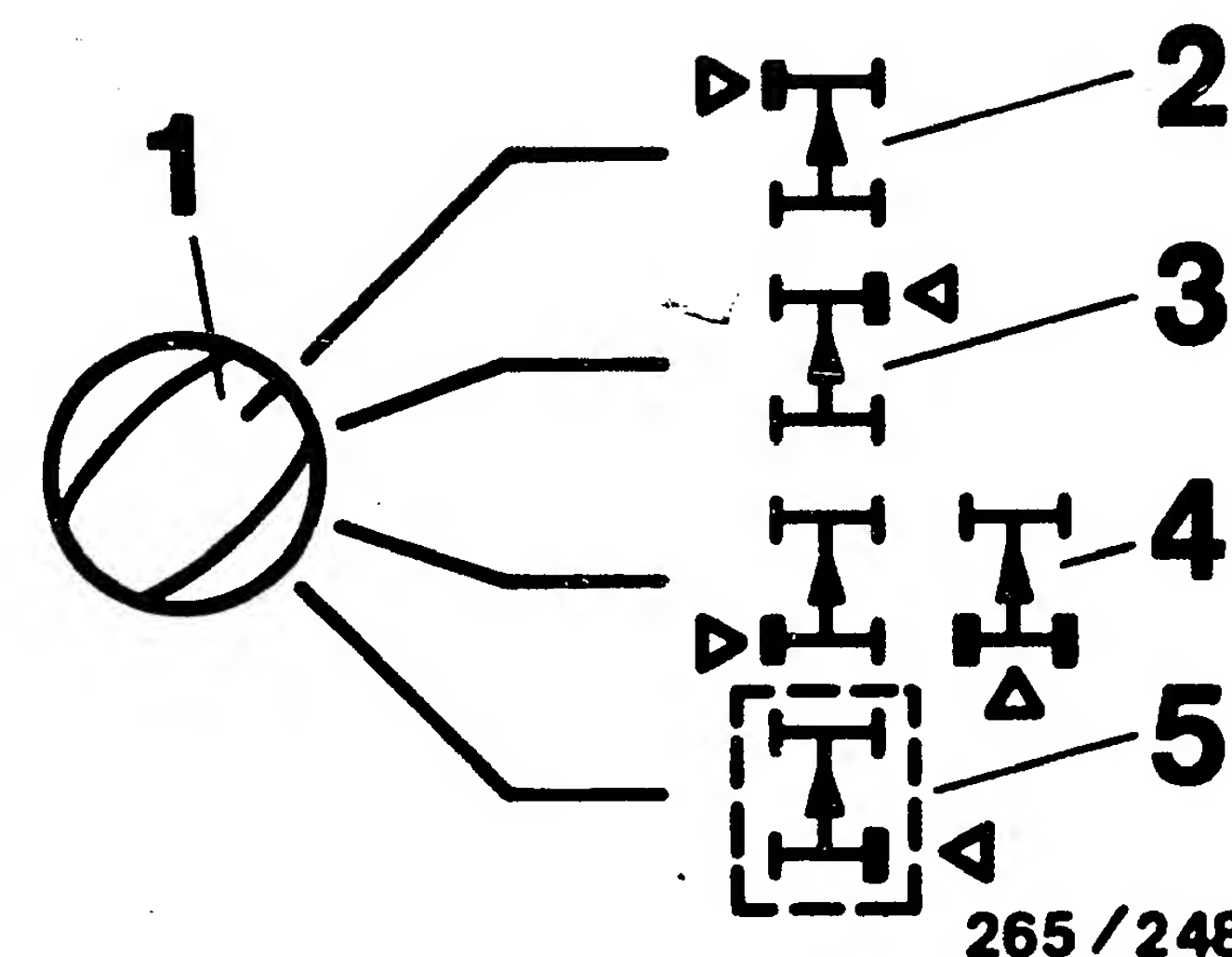


**RAPID DIAGNOSIS CHART (CONTINUED)**  
**Program-selector-switch position 5 (3-channel hydraulic modulator)**

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve-relay operation (term.27)	Ignition on	LED 3 (upper illustration) lights up	* Valve relay (winding) or leads defective
Solenoid-operated valve in hydraulic modulator for operation and mix-up. <b>NOTE:</b> Check each wheel separately in turn. Keep to operating sequence!	Choke up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. For the rear axle, set to position 4 (lower illustration).		<ul style="list-style-type: none"> <li>* Repeat test with engine running</li> <li>* Valve relay (make contact) defective</li> <li>* Break in line from valve relay term. 87 to batt. +ve</li> <li>* Brake leads at hydraulic modulator mixed up</li> </ul>
Operation pressure holding	1. Constantly press push-button P= (lower illus.)	LED P= (lower illus.) lights up	<ul style="list-style-type: none"> <li>* Current value not obtained (LED P arrow or P= goes out; upper illustration); battery insufficiently charged. Repeat check with engine running.</li> </ul>
	2. Constantly depress brake pedal	Wheel turnable by hand	
	3. Release push-button P= (upper illustration)	LED P= goes out (upper illus.) Wheel locks	
Operation pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	<ul style="list-style-type: none"> <li>* Solenoid-op. valves correctly connected electrically? Wheel, front left: term.2 Wheel, front right: term.35 Wheel, rear left: term.- Wheel, rear right: term.- Rear axle: term.18</li> <li>* Hydraulic modulator defective</li> </ul>
	5. Release push-button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6. Release brake pedal		



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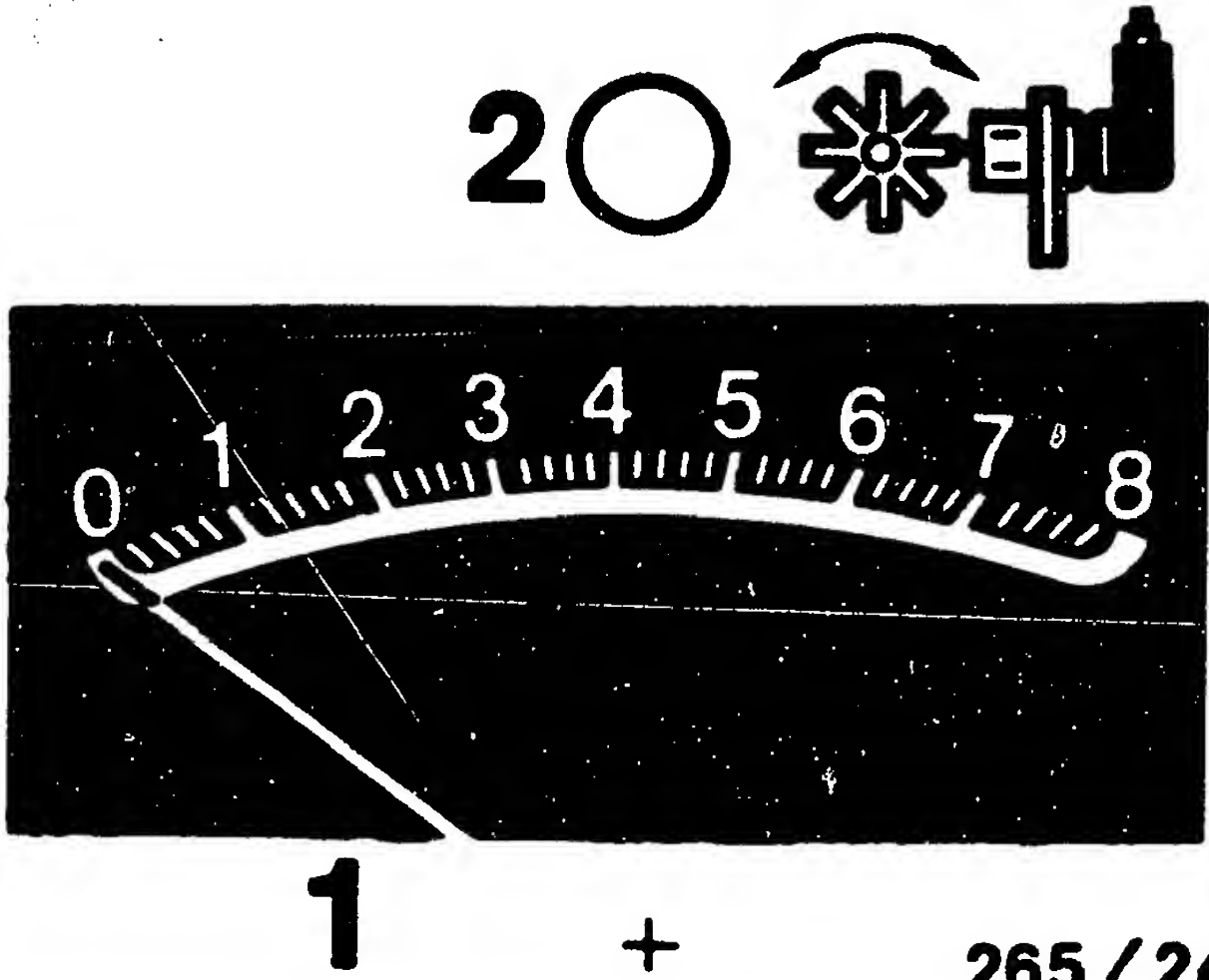
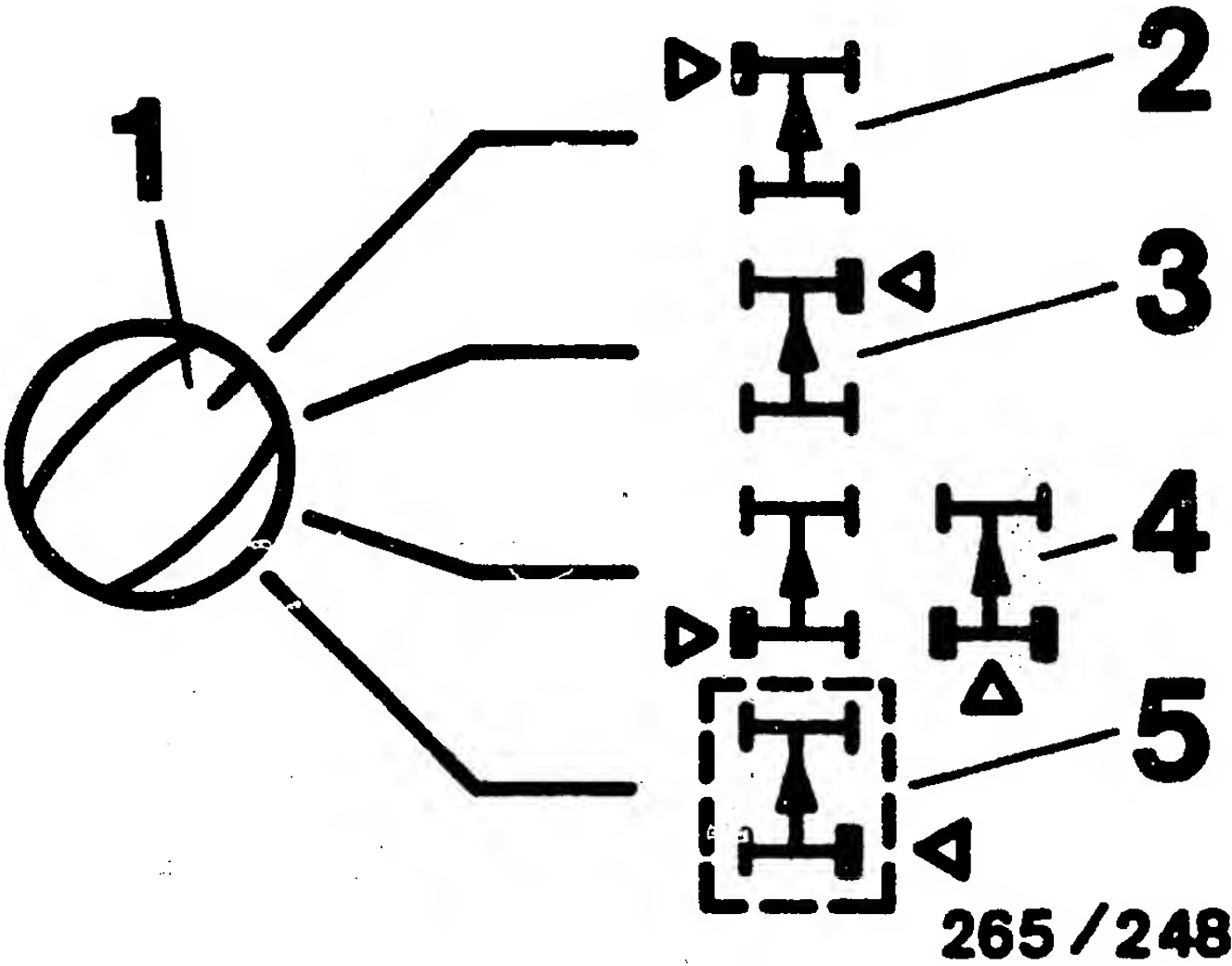


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RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch setting 6 (4 wheel-speed sensor)

Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Wheel-speed sensor for proper func- tioning and mix-up  NOTE: Perform test consecutively for each individual wheel.  Wheel, front left: term.4 + term.22  Wheel, front right: term.23 + term.21 on 80/90/100/200 quattro as of approx. 1.88 term.21 + term.25  Wheel, rear left: term.8 + term.9  Wheel, rear left: term.24 + term.26	Jack up vehicle. Ignition on.  It must be possible to turn the wheel to be tested freely by hand.  The wheel not being tested must be held when testing the driven axle.  Set switch for wheel selection to wheel to be tested (bottom picture)  Turn wheel by hand until LED 2 above instrument lights up without flickering. (Speed approx. 1 rev- olution per second). Then read off value indicated on instrument: (top picture)	1. Smallest reading greater than 1,0 scale divisions  2. Smallest reading greater than 1,6 scale divisions  3. Permissible fluctuation band max. 11 % of maximum value displayed.	*Wheel-speed-sensor lead mixed up  *Open-circuit in wheel- speed-sensor lead  *Wheel-spd.-sens. defect.  Winding resistance front and rear axle: 0,6...1,6 k $\Omega$  *Excessive air gap between wheel-speed sensor and ring gear  *Ring gear defective or loose  *Ring gear installed has incorrect no. of teeth Front axle: 96 teeth Rear axle: 96 teeth On Audi 80/90/100/200 quattro as of approx. 1. 88 Front axle: 45 teeth Rear axle: 45 teeth *Excessive wheel bearing play *Reading given, LED 2 does not light up: Loose contact in wheel- speed-sensor lead.



Continue testing on next coordinate.



## CHECKING DIFFERENTIAL LOCK

Pressing the button (DIFF) in the center console activates/deactivates the rear differential lock.

The control unit automatically deactivates the differential lock at speeds in excess of 25 km/h and prevents actuation at speeds in excess of 25 km/h by way of the switch for the differential lock.

Activate rear differential lock at speed of less than 25 km/h.  
ABS warning lamp must light.

Increase speed to in excess of 25 km/h.  
ABS warning lamp goes out.

If functions are not OK, check electrical actuation of differential lock.  
If this is working properly, replace control unit of differential lock and repeat test.

Check differential lock (electrical actuation).

Pull plug off control unit of differential lock with ignition switched off. At control-unit plug (X8) consecutively measure voltage between terminals 15 and 31 / L and 31.  
Ignition on.

Set value: approx. battery voltage

If set values are not attained, check leads from control-unit plug to ABS combination relay as well as ground lead and function of indicator lamp H2.

Measure voltage at control-unit plug (X8) between terminals T and 31.

Set value: approx. 0 V

Press and hold switch for differential lock (DIFF).

Set value: approx. battery voltage

If set value is not attained, check leads from control-unit plug to switch of differential lock/transmission switch of differential lock.

Measure voltage at control-unit plug (X8) between terminals V and 31.

Set value: 8...10 V

If set value is not attained, check lead from control-unit plug to speedometer.



## TEST SPECIFICATIONS

### Wheel-speed sensor

- \* Winding resistance at ambient temperature (-10°C...+120°C) for front axle:
- rear axle:

600...1600  $\Omega$   
600...1600  $\Omega$

### Hydraulic-modulator solenoid valves

- \* Winding resistance at ambient temperature (-10°C...+120°C):

0,7...1,7  $\Omega$

### Air gap

0,8  $\pm$ 0,5 mm

- \* Automatic adjustment if use is made of new cap with Part No. 3 330 508 012.

### Tightening torque for

- \* fastening screws of wheel-speed sensors:

> 8 Nm

- \* brake-line connections at hydraulic modulator:

12...16 Nm

### Number of teeth:

- \* Front axle:
- \* Rear axle:

96 teeth  
96 teeth

### Audi 80/90 as of 01.88

- \* Front axle:
- \* Rear axle:

45 teeth  
45 teeth

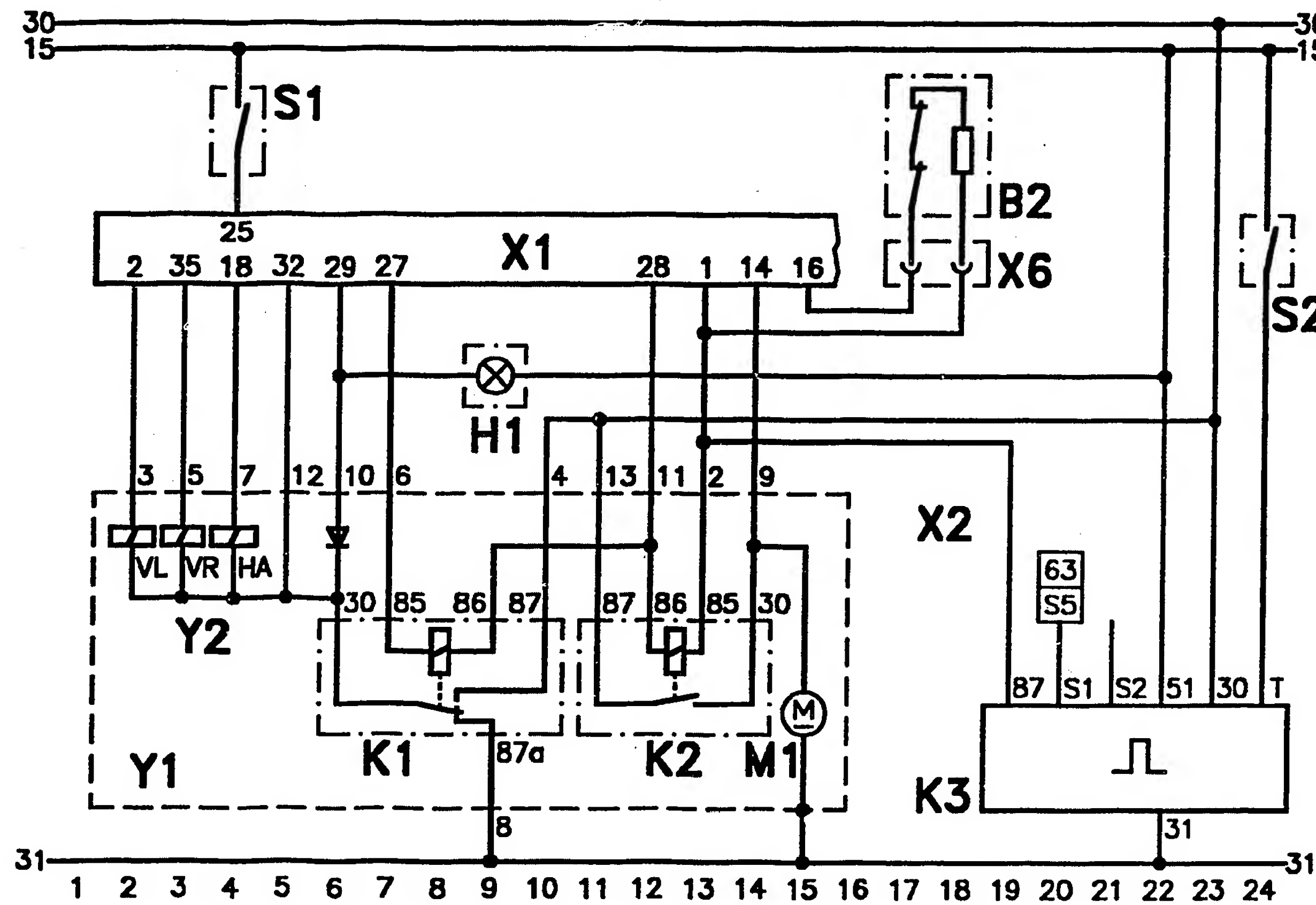
### Acceleration sensor

- \* Contacts closed given horizontal position:

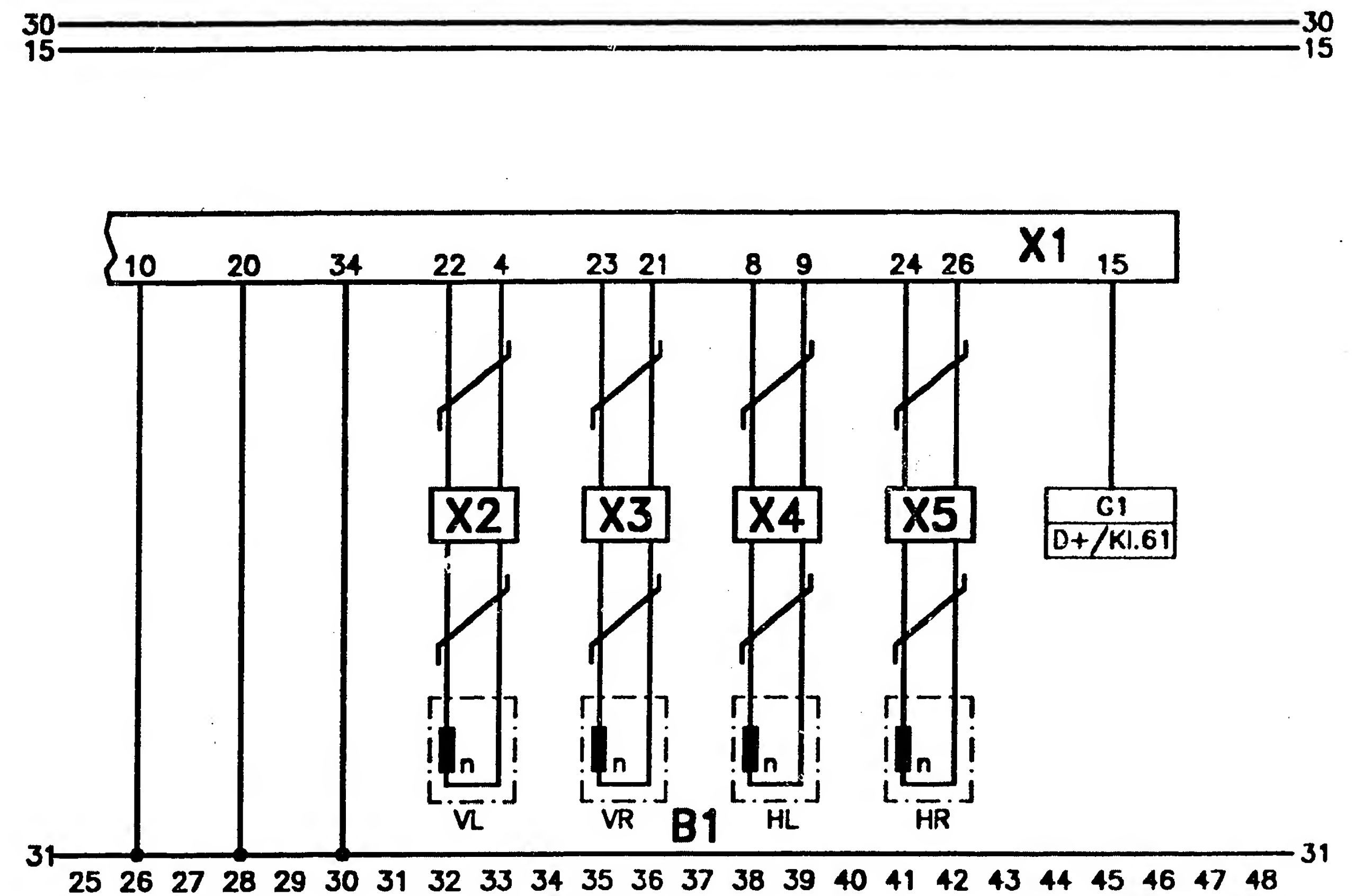
500...600  $\Omega$

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KFB00992



KFB00993



B1 = Wheel-speed sensor  
 B2 = Acceleration sensor (a<sub>L</sub>)  
 H1 = ABS warning lamp  
 G1 = to alternator  
 K1 = Valve relay  
 K2 = Motor relay  
 K3 = Combi relay

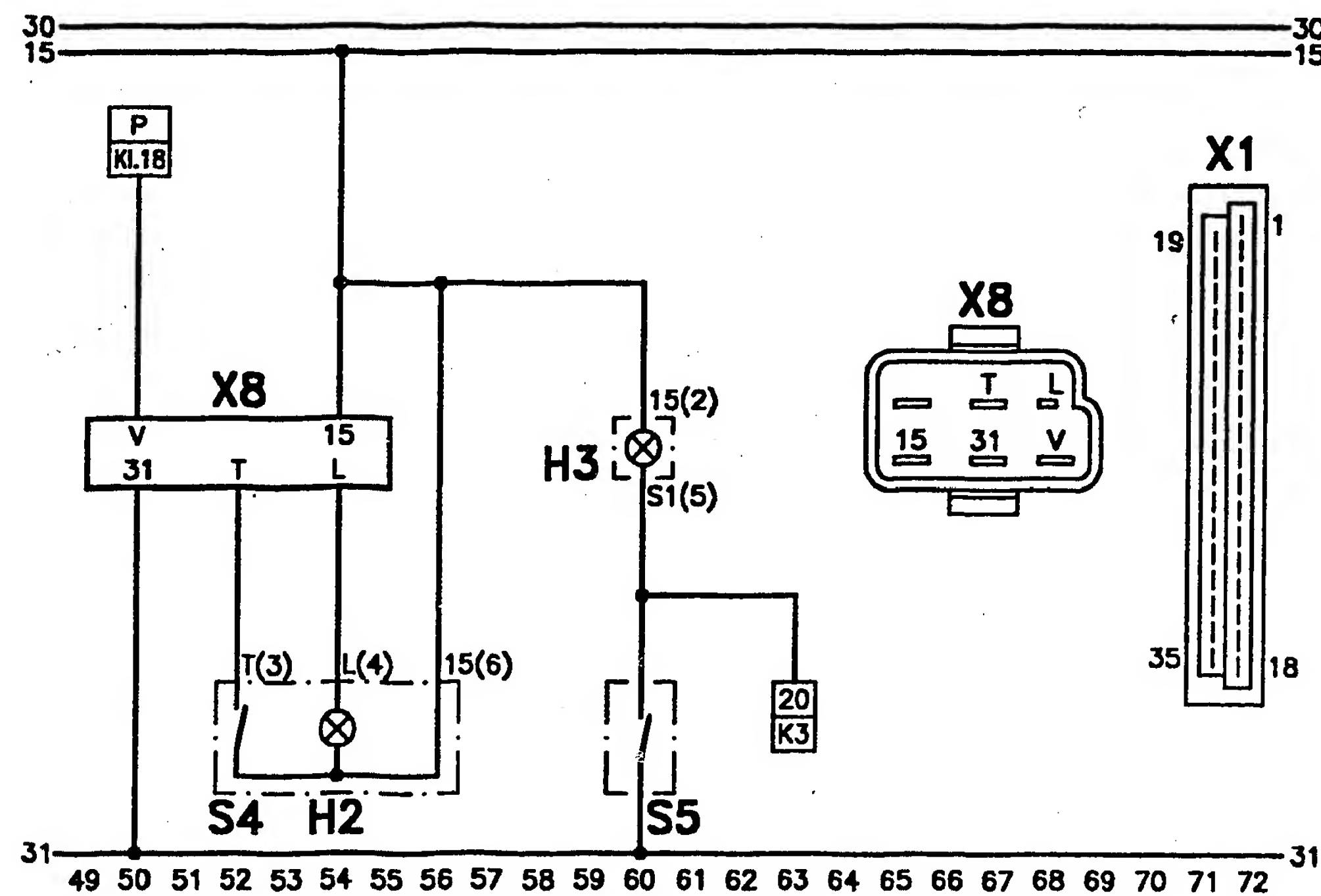
M1 = Return-pump motor  
 S1 = ABS button  
 S2 = Stop-lamp switch  
 X1 = Controller plug (35-pole)  
 X2...X6 = Multiple butt connector  
 Y1 = Hydraulic modulator  
 Y2 = Solenoid valves

VL = Front left  
 VR = Front right  
 HA = Rear axle  
 HL = Rear left  
 HR = Rear right

ELECTRICAL TERMINAL DIAGRAM -&gt;1.88

C23

C24



- H2 = Indicator lamp for differential lock  
H3 = Indicator lamp for rear differential lock  
P = Speedometer  
S4 = Switch for differential lock  
S5 = Transmission switch for differential lock/final drive, rear  
X1 = ABS controller plug (35-pin)  
X8 = Control-unit plug, differential lock

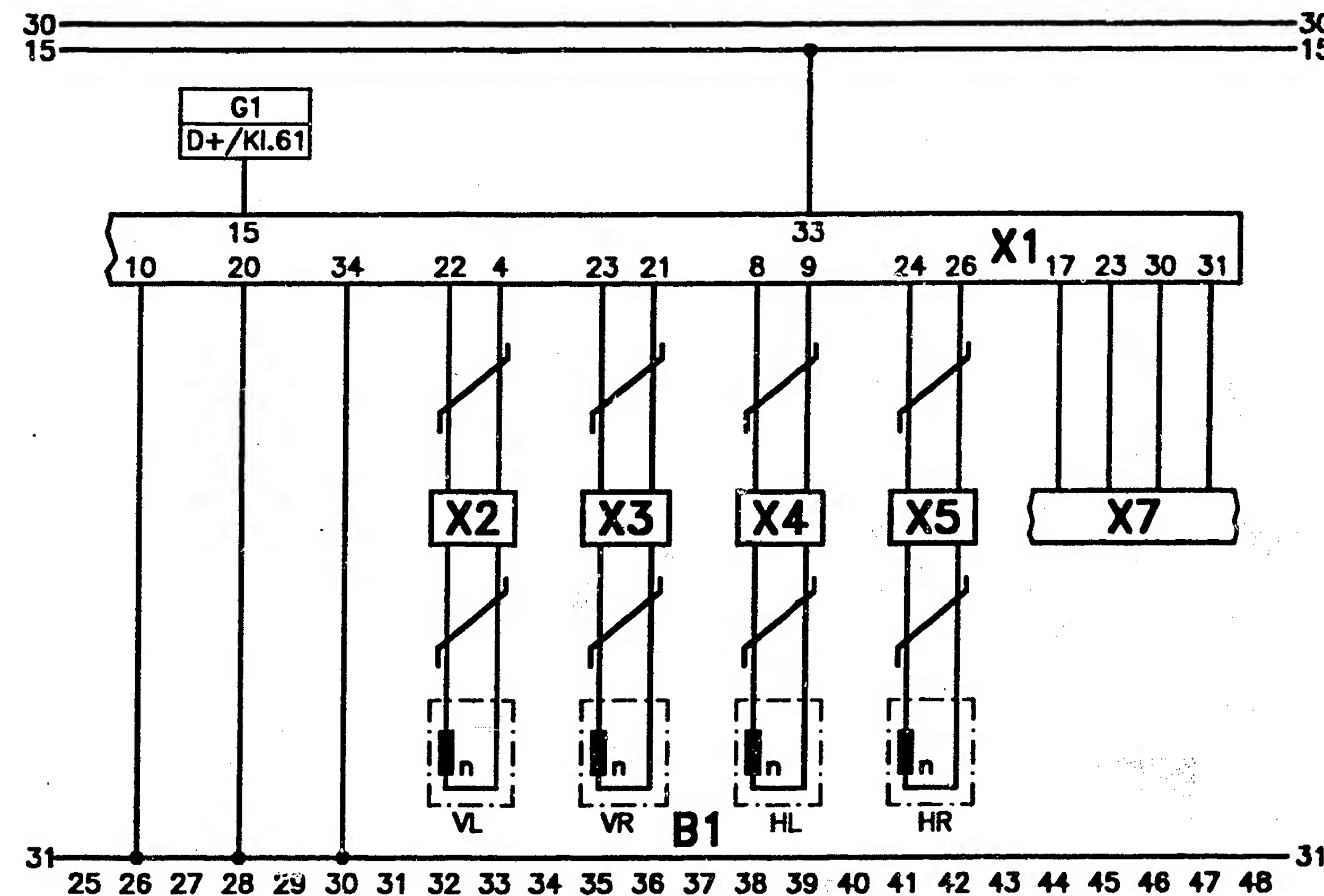
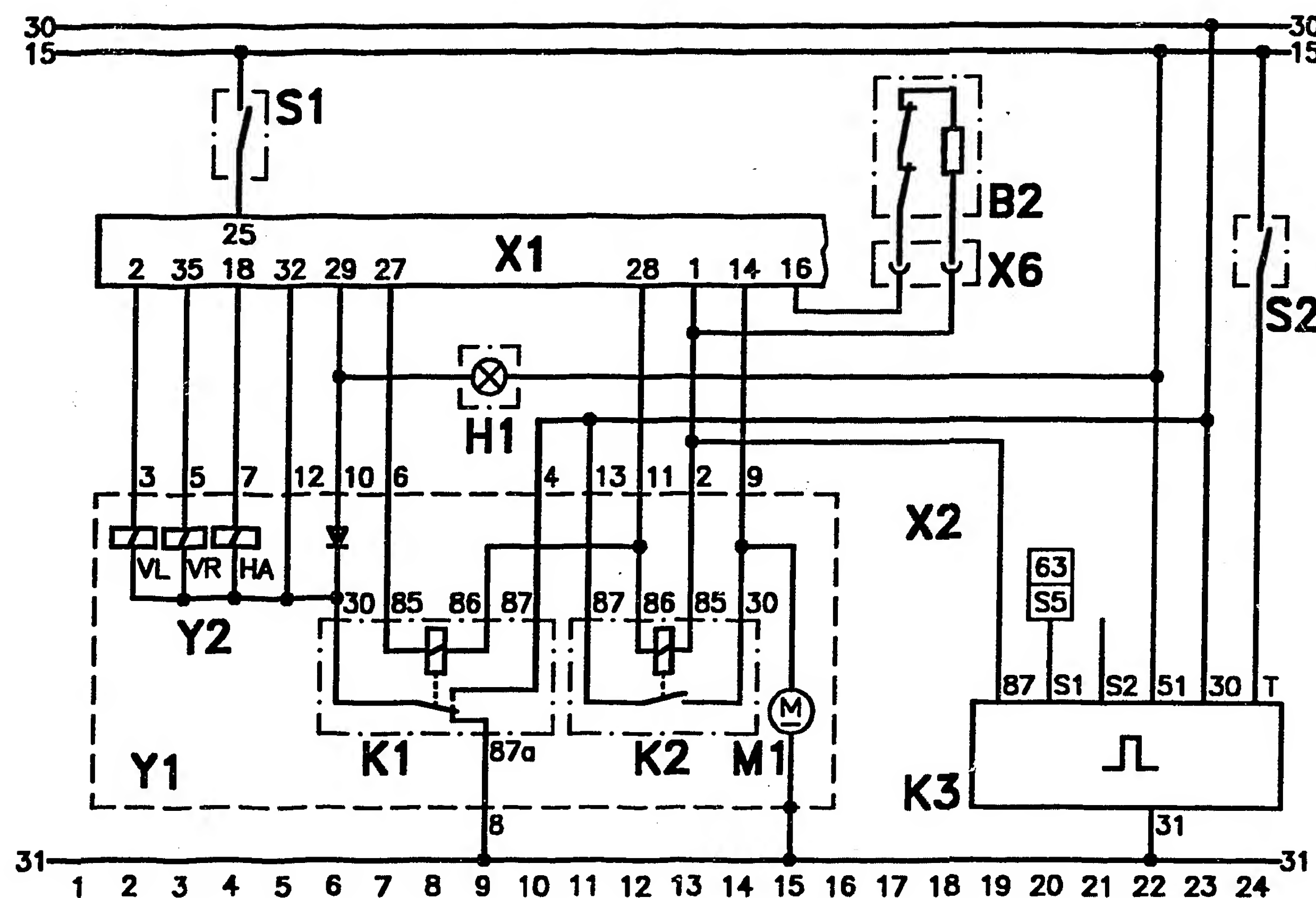
## ELECTRICAL TERMINAL DIAGRAM

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KFB00995

KFB00996



B1 = Wheel-speed sensor  
 B2 = Acceleration sensor (a<sub>L</sub>)  
 H1 = ABS warning lamp  
 G1 = to alternator  
 K1 = Valve relay  
 K2 = Motor relay  
 K3 = Combi relay

M1 = Return-pump motor  
 S1 = ABS button  
 S2 = Stop-lamp switch  
 X1 = Controller plug (35-pole)  
 X2...X6 = Multiple butt connector  
 X7 = Plug, wheel-speed-sensor outputs  
 Y1 = Hydraulic modulator

Y2 = Solenoid valves

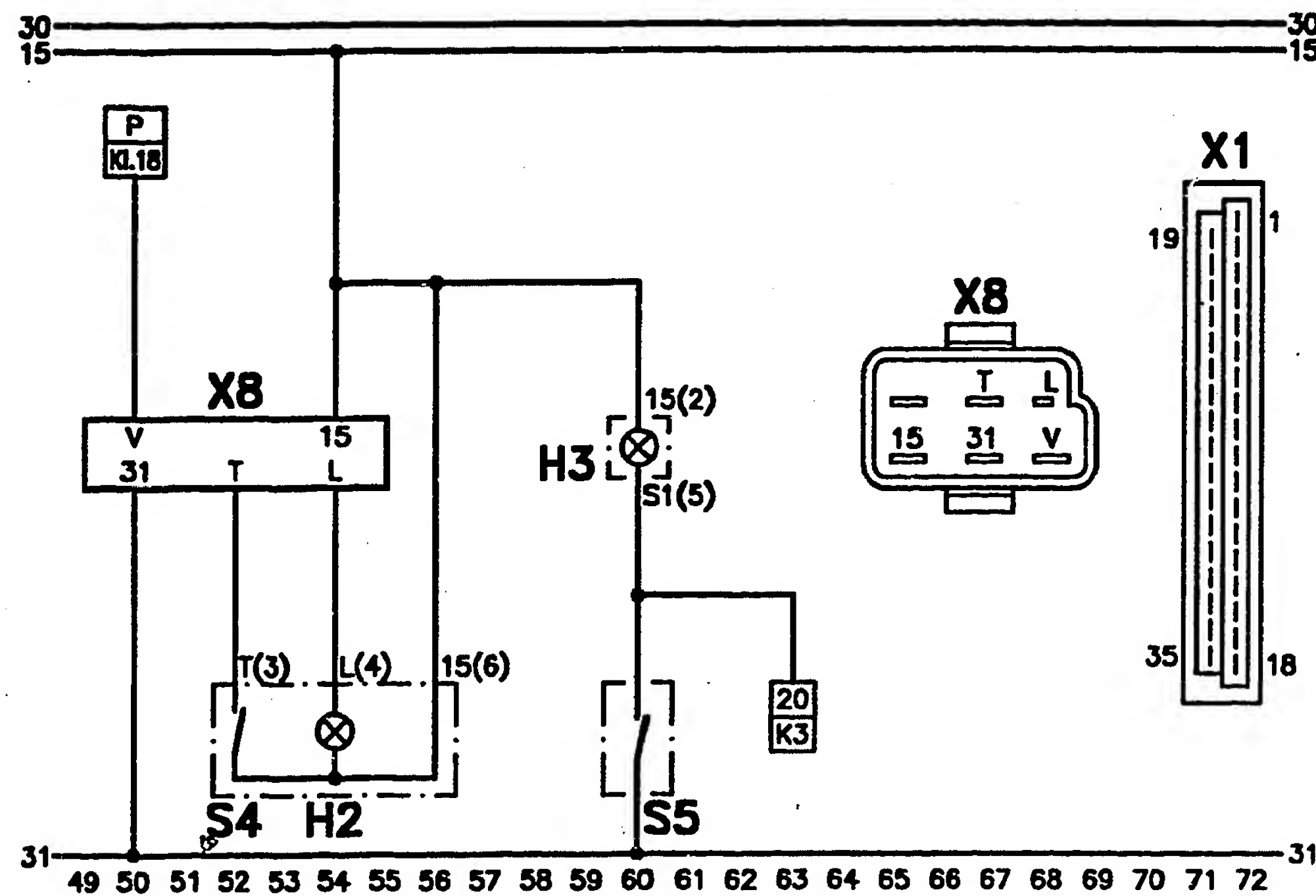
VL = Front left  
 VR = Front right  
 HA = Rear axle  
 HL = Rear left  
 HR = Rear right

ELECTRICAL TERMINAL DIAGRAM (with additional wheel-speed-sensor outputs) 1.88 —>

C27

C28

KFB00994



- H2 = Indicator lamp for differential lock
- H3 = Indicator lamp for rear differential lock
- P = Speedometer
- S4 = Switch for differential lock
- S5 = Transmission switch for differential lock/final drive, rear
- X1 = ABS controller plug (35-pin)
- X8 = Control-unit plug, differential lock

# ELECTRICAL TERMINAL DIAGRAM

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# INSTALLATION POSITION OF COMPONENTS

The installation locations always refer to the direction of travel.

- \* Controller (top picture):  
Beneath seat bench, rear left.

AUDI 100/200 quattro: Beneath rear seat bench, on left, at heel board.

AUDI 80/90 quattro as of 1987: Beneath rear seat bench, left.

AUDI 80/90 quattro up to 1987: In trunk, right, next to fuel tank.

AUDI Coupe quattro up to 1988: In trunk, right, next to fuel tank.

AUDI quattro: In trunk, right, next to fuel tank

- \* Stop-lamp switch:  
At brake pedal.

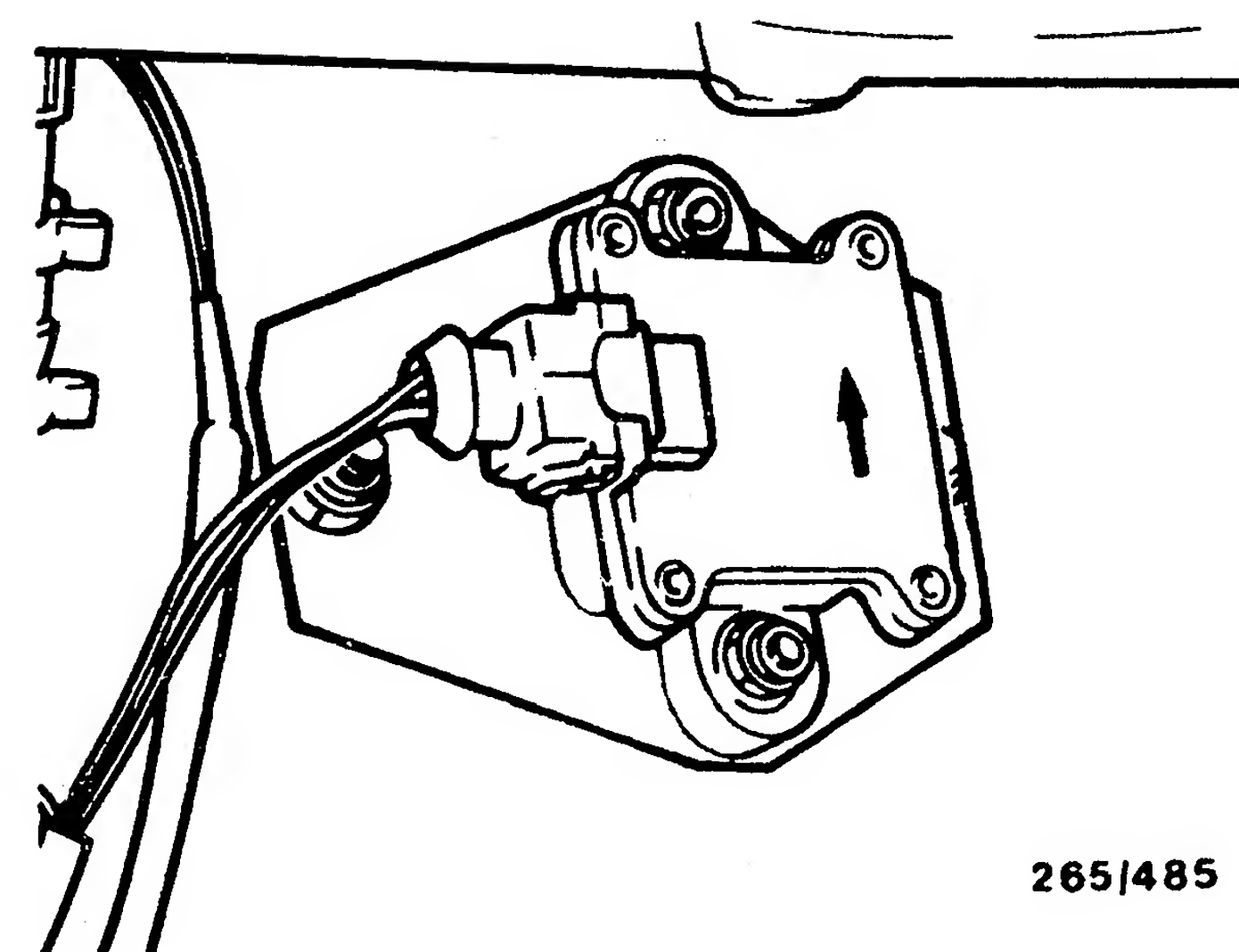
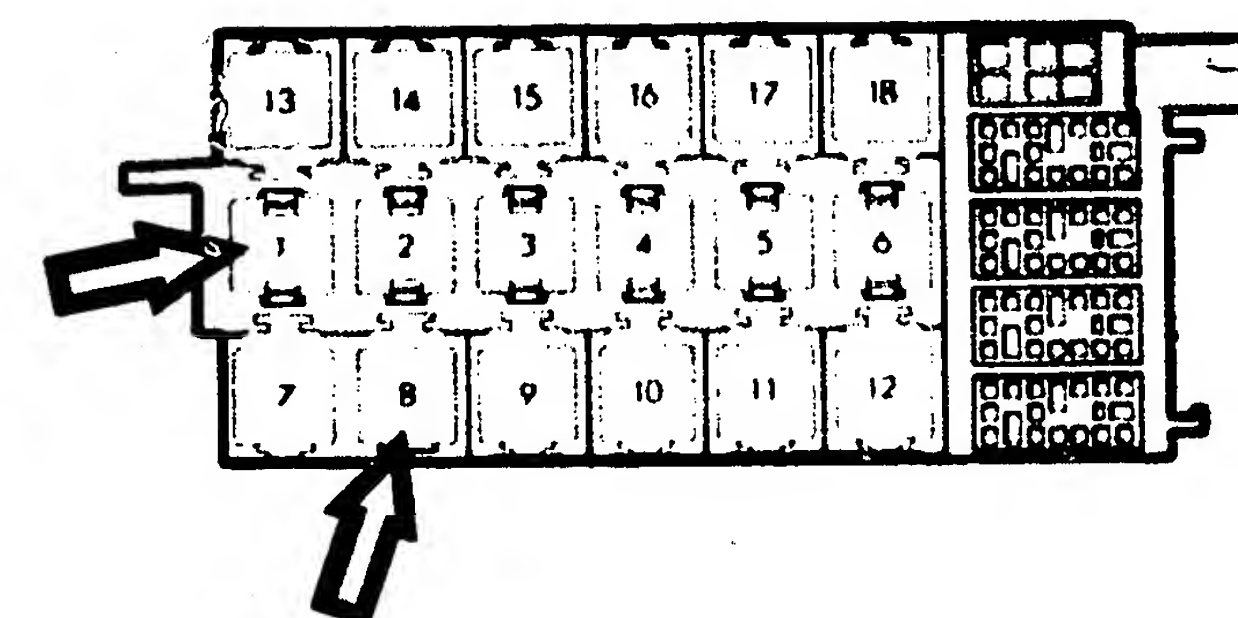
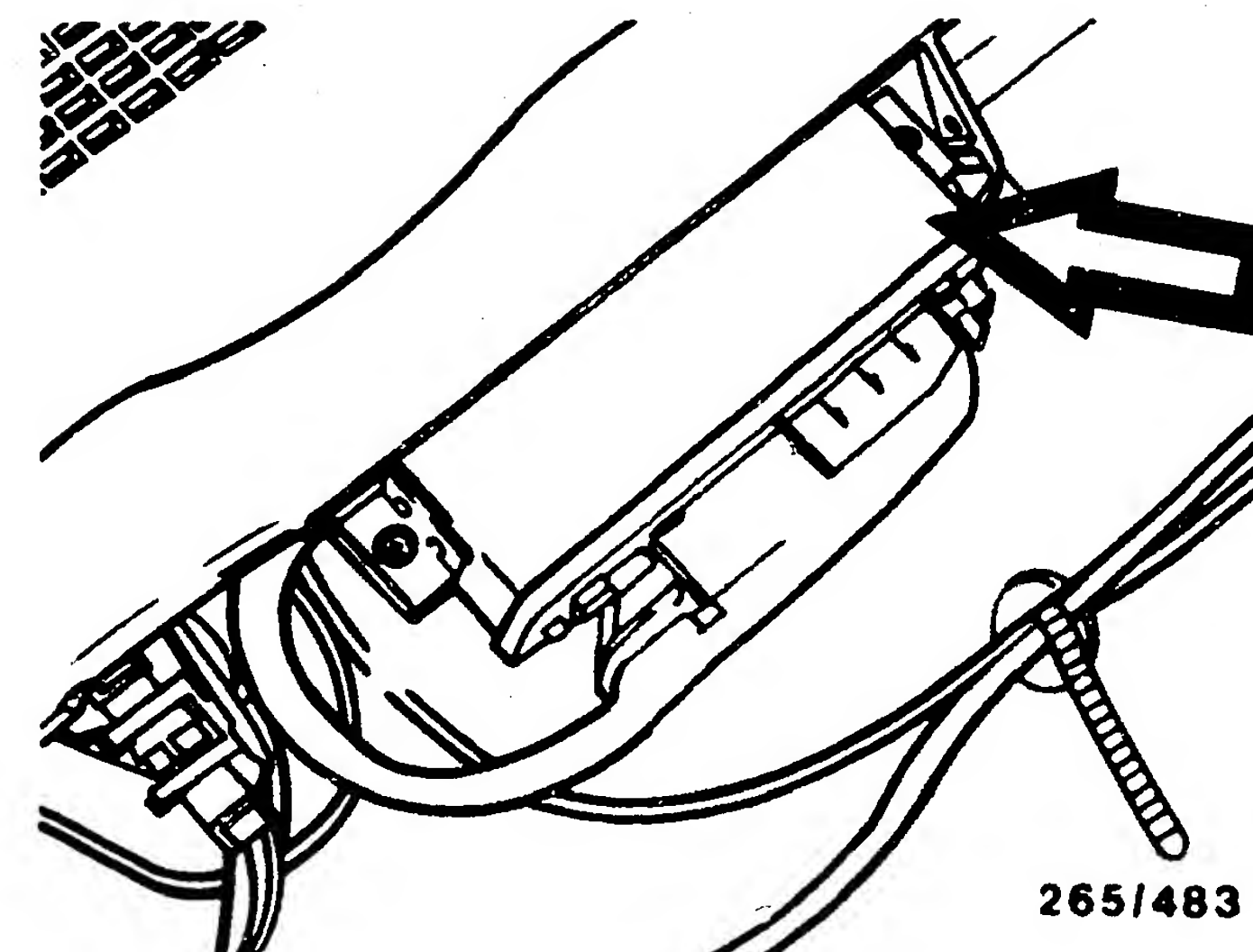
- \* ABS warning lamp:  
In instrument panel.

- \* ABS switch:  
In instrument panel

- \* Combi relay (center picture):  
Front left beneath instrument panel, relay position 1 in auxiliary relay holder on Audi 80/90 quattro or relay position 8 on Audi 100/200 quattro, 5000 quattro.

- \* Ground terminal for ABS:  
AUDI 80/90 quattro: Behind instrument panel, left  
AUDI 100/200 quattro, 5000 quattro: Beneath rear seat bench, right.

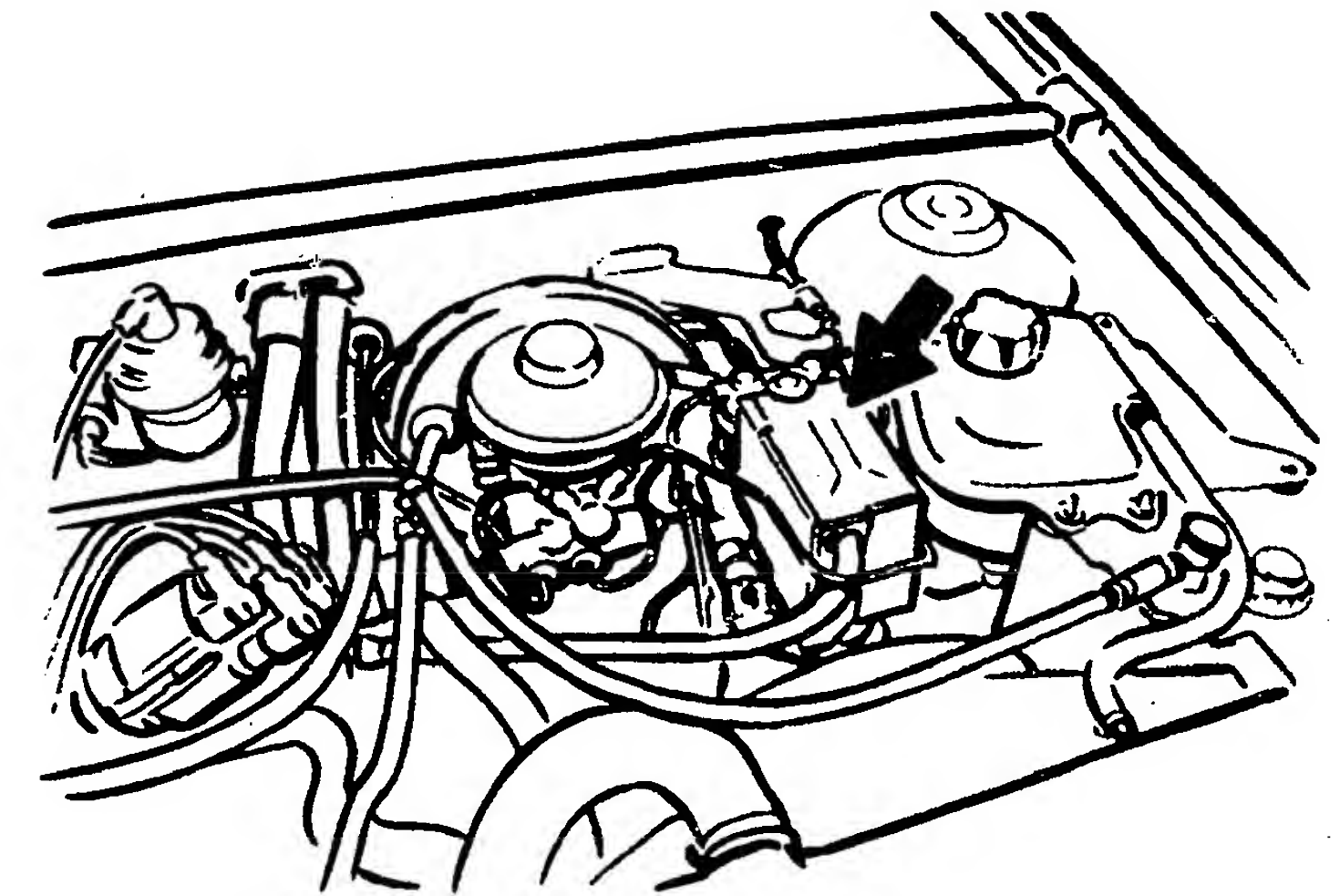
- \* Acceleration sensor (a<sub>L</sub>) (bottom picture):  
Beneath seat bench, rear left.  
Arrow a on sensor faces in direction of travel.





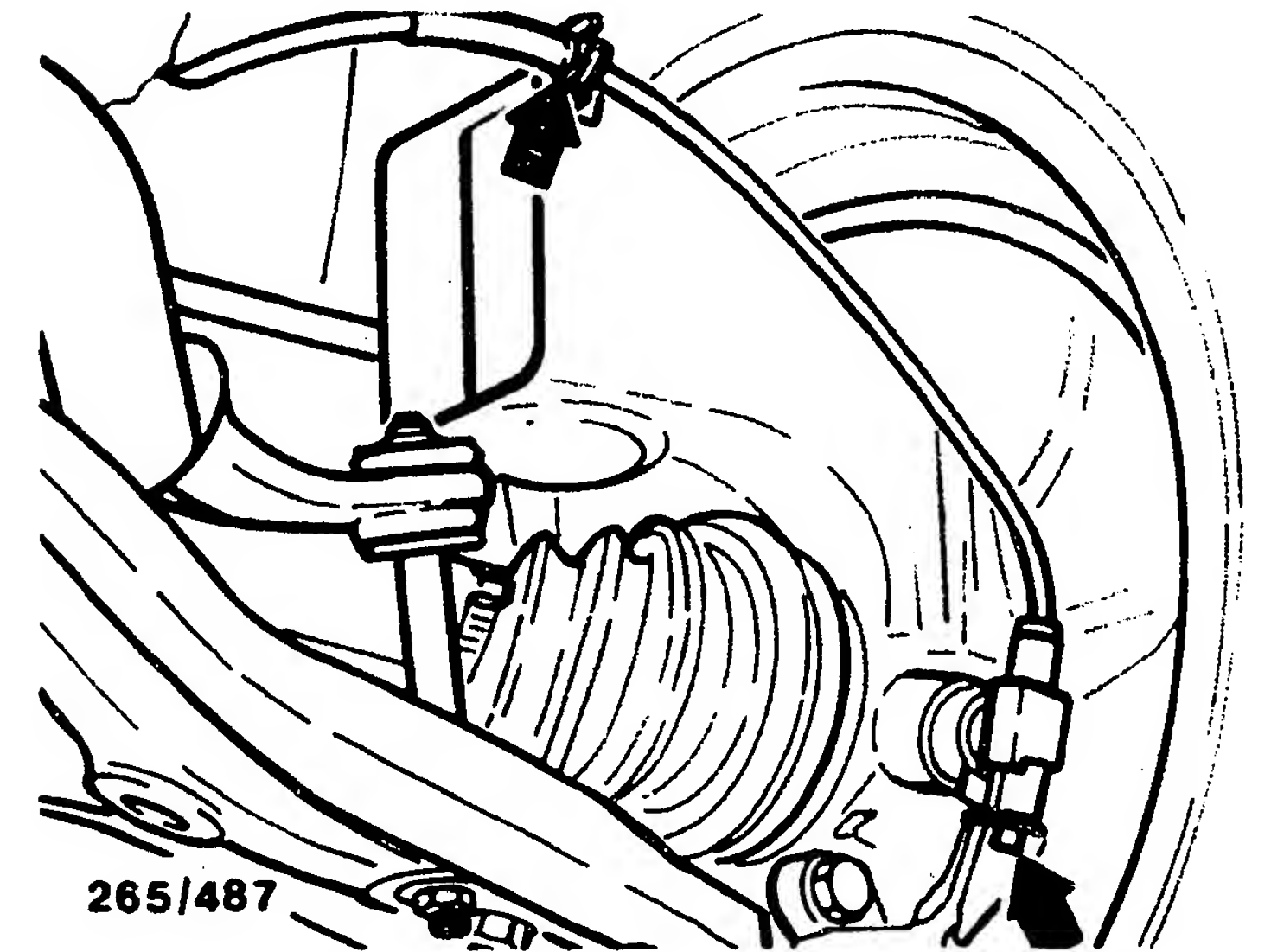
## INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- \* Hydraulic modulator (top picture):  
In engine compartment on left in direction of travel.



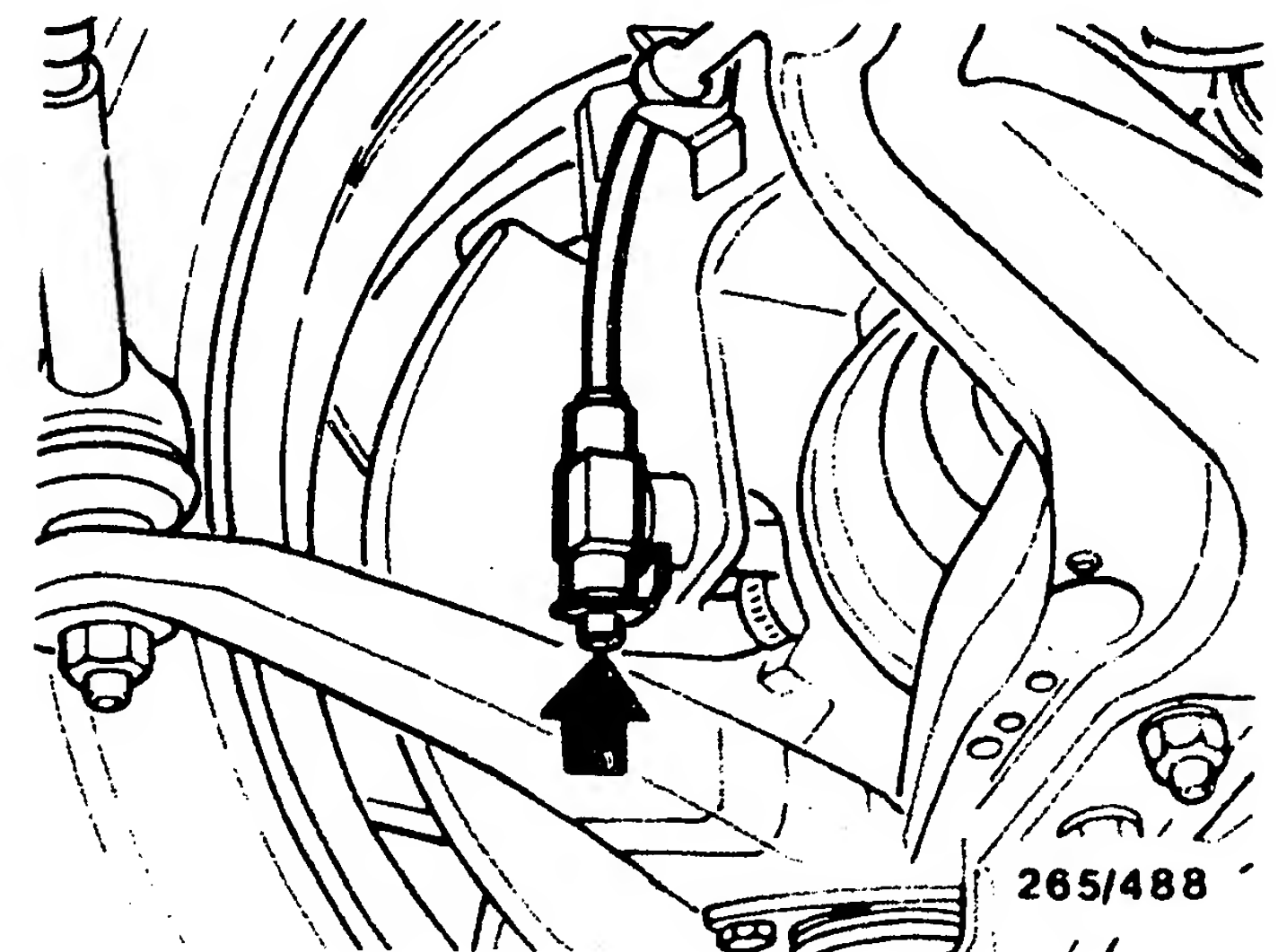
265/486

- \* Front-axle wheel-speed sensor (center picture):  
Attached on inside on right and left in wheel bearing housing.



265/487

- \* Rear-axle wheel-speed sensor (bottom picture):  
One each on left and right at wheel bearing housing.



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